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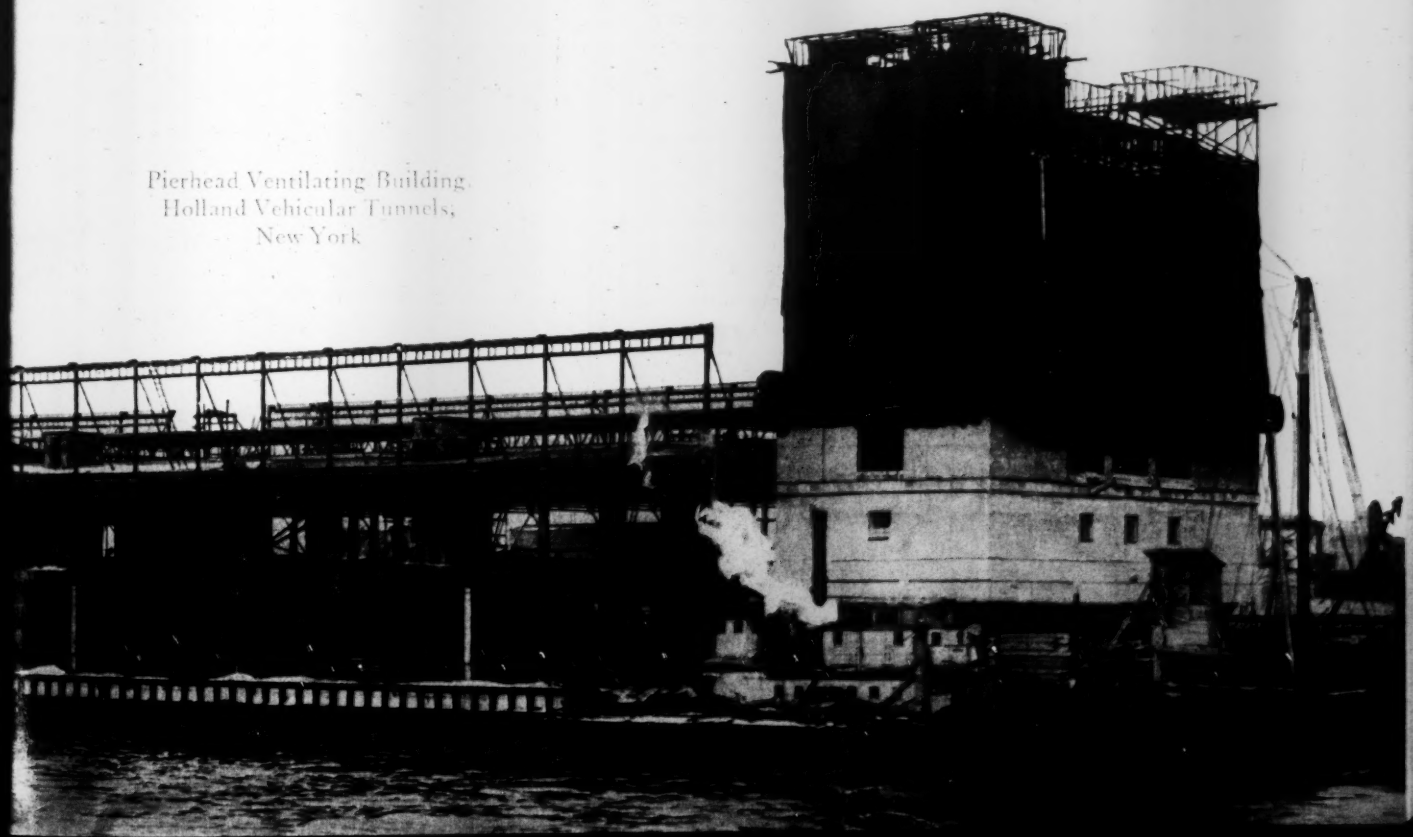
June 9, 1927

Studies and Adopted Methods for Ventilating the Holland Tunnels

Construction Procedure on Two Arc-Welded Buildings

Efficiency and Economy of Chlorinating Sewage Tank Effluent

Proportioning Steel Slabs for Column Bases



Pierhead Ventilating Building, Holland Vehicular Tunnels, New York

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Calm Thought Needed

FOREWARNING of what may be expected in Washington next December was given at the flood-control conference held at Chicago last week. For three days an enthusiastic gathering listened to speeches. No debate was allowed, but everyone who had an oration on the necessity for federal expenditure to prevent a recurrence of the flood was given his chance. Politics, at least partisan politics, was discreetly submerged and Senators Watson and Harrison and Speaker Longworth and Mayor Thompson forgot their manifest differences and indulged in one grand love feast, the keynote of which was that the Mississippi Valley must be saved at any cost. It is perhaps too early to inject a note of discord in this concert, but sooner or later that note will be heard. This is a rich country. We can spend thirty odd billions on a war and emerge the wonder and envy of a less prosperous world. When we commence talking of the Mississippi problem as a national obligation we are talking the same kind of figures we use when we talk about war. It is not a question of millions to make the valley "safe for all time." It is a matter of billions, and then we are not too sure of what we will get. Maybe the census of destruction will show that billions are warranted to prevent another flood, maybe the time has come when the nation as a whole must take responsibility for every water course and every water source, but let us not be driven by hysteria onto such a road without trying to see whither it leads. History may be made in the Mississippi flood legislation now apparently so imminent, history that will affect all of our future power production, waterway transportation and reclamation policies. By December a degree of calm will have been reached in consideration of the major issues here involved—and by then let us hope that there will be those in Congress who will see where this snap oratory and opinion of today are leading us.

No Secret Engineering

CONSIDERATION of the implications of its summary supplanting of its own engineers has apparently led the North Jersey District Water Supply Commission to walk cautiously. As noted in our news columns the commission will appoint another consulting engineer to pass upon the question of steel pipe versus concrete aqueduct and to report also upon the other differences of opinion between Messrs. Pratt and Sherrerd, the commission's regular engineers, and Col. George A. Johnson who was brought in a few months ago to report on the aqueduct design. Upon the technical points at issue no one outside the commission can pass for the opposing reports continue to be kept secret, but Mayor Raymond, of Newark, a member of the commission, showed signs at last week's hearing that he at least of the commission had begun to appreciate that a body representing a widely diverse group of communities could not call for a radical change in its own plans and a possible large expenditure of money solely upon a secret engineering report overthrowing a long standing and accepted plan. So far no engineer outside of those directly concerned can say whether Colonel Johnson's criticism of the accepted plan is justified or not, but that gentleman would do well to urge the commission to make fully public as soon as possible all of the technical data of his report and of the investigation behind it. Public engineering is not properly carried on behind closed doors.

Road Sign Queries

WITH formal publication of a manual and specifications and the adoption by over thirty states of standard signs and markers for United States roads, conditions bid fair for having in America in a few years a uniformly marked road system of some 80,000 miles. To one who reflects on the conditions of no marking and of odd marking which prevailed only a few years ago, this accomplishment in simplification and standardization is noteworthy. There will not be for a little time complete compliance in all states with standard marking because some states require legislation permitting compliance, others invariably are laggard and a few have too strong a conceit in their independence and individualism to accede easily to concerted action. Some time, however, there will be full compliance. Those who have worked out the standards now being accepted and put in use by 33 states express belief that they will be by 1928 applied to all United States roads. Let us be optimistic and grant the date. Then, to use a colloquialism, where do we go from there? Is it the best that road engineers can agree upon that a few across-country routes are so marked that a traveler does not have to learn a new set of signs and markers in each state he enters? There are 200,000 miles of state roads and half a million miles of surfaced roads not much less traveled than the 80,000 miles of United States roads and by the same token as much deserving of being uniformly marked. Will the association of state highway officials which has done such good work with the United States roads do as much for the bigger system of state roads?

Research to the Fore

RESEARCH by industry may look forward to a great gain through the organization of the Steel Corporation's new research department on the high scientific basis assured for it by the selection of Dr. John Johnston as head. The corporation's announcement of its plans, some months ago, to enter into research was an agree-

able surprise, and the pleasure is now heightened by the promise that this work will be fundamental and scientific. Such work is indispensable if the practices of technologic craftsmanship and traditional method are to be transformed into controlled and definitely known process. Many people have come to believe in recent years that the most formidable element of the great steel industry did not recognize this, but was interested only in production and tonnage, in doing today on a larger scale what it did yesterday. And well informed voices sounded warning from time to time that despite all advantages of ore, fuel and markets, this was not a sound way to assure the future. Nevertheless, the industry continued to prosper, and to amass steadily greater wealth on the old basis. But meanwhile every other field of technology had turned to research as a vital adjunct to business—soap making, textile manufacture and power production. Introduction of industrial research into production has in fact been the great evolutionary process in the field of the material arts during the past two decades. It has come to be a truism that commercial leadership cannot persist unless it has research as an inseparable companion. Now that an art which is among the oldest and noblest of all joins the ranks of the others, the fabric of industrial research will be strengthened even more. The growth and fruitfulness of industrial research will gain from the stimulus.

Paying for Service

THE total cost of government in the United States, according to the National Industrial Conference Board, in 1925 amounted to $11,124,000,000. In 1913 it was only $2,919,000,000. Per capita in 1925 this amounted to $96.41 as against a comparable $30.24 in 1913, but reducing the 1925 per capita to a comparable 1913 dollar value the 1925 unit would be $57.17, which is almost twice the expenditure of the last pre-war year. These figures are given by the board, and are generally quoted, to indicate an ominous increase in the cost of government, a dangerous tendency that must be curbed. Probably this is true but there is another side of the picture. It is that this $96.41 is divided into $32.63 for the federal government, $13.26 for the states and $50.52 for the local governments. More than half of the money, therefore, is going to the towns, cities and counties. This is direct service, at least much more direct than that given by the states or by the nation. This money goes for schools, for streets and township roads, for garbage collection and sewage disposal, for police and for fire departments. Doubtless there are economies to be made in these expenditures but when they are made they should be balanced against the need of the services. These services are not the intangibles that the unregenerate cry out against, these are not the chairwarmers or the scientists or the snoopers of Washington; they are the life and living of our communities. These communities are becoming better places to live in every year and their inhabitants are continually demanding better services. If they are getting these improvements they should be willing to pay for them and to remember when they deplore the overwhelming increase in cost of government just how much of that increase is due to the things they are demanding and are getting. Expenditure is not necessarily waste.

Holland Tunnel Ventilation

WITHIN a few months, results of the elaborate studies on vehicular tunnel ventilation carried out by the commissions charged with building the Holland Tunnels at New York will be put to a practical test. When the studies were begun in 1919 no comparable tunnel ever had been built and there were practically no data upon which to base designs. Consequently, much pioneer work had to be done, and no small amount of material relating to the ventilation of such long vehicular passageways built primarily for motor vehicles, such as the effect of motor gases on human beings and the flow of air through long passageways, has been assembled and made available.

In the early stages of the work the transverse method of ventilation, that by which fresh air is supplied to the tunnel at short intervals from a parallel duct and vitiated air is drawn off through numerous openings to an exhaust duct, was adopted as promising to be most satisfactory for such a tunnel. Transverse ventilation in itself was a novelty at that time, all previous tunnels having been ventilated by a longitudinal movement of the air, either natural or forced, and the method has been attacked as being more expensive and less positive than longitudinal ventilation, particularly since the completion and successful operation of the Liberty Tunnels at Pittsburgh, where longitudinal ventilation is used. However, although the total length of the Liberty and Holland Tunnels is comparable, the physical conditions which tend to induce natural ventilation are quite different and the psychological effect produced by driving down under a river is so different from that produced by driving into a tunnel under a hill that what has been found satisfactory for Pittsburgh will not, necessarily, be satisfactory at New York. Conditions at New York require that the ventilation of the Holland Tunnels be as nearly perfect as possible regardless of expense.

Of the two systems the transverse method, theoretically at least, insures a more uniform supply of fresh air at all points in the tunnel. In the case of a blockade in the Holland Tunnels such as occurred in the Liberty Tunnels before the ventilating system was installed, the consciousness of a stream of fresh air flowing into the tunnel at the side of each car, as will be the case in that tunnel, should go a long way toward preventing a panic such as occurred in the Liberty Tunnels. Air pollution, however, from the operator's viewpoint, is not the most difficult problem connected with tunnel ventilation because with either system the margin of safety between the security aimed at in designing the system and a dangerous concentration of carbon-monoxide gas is wide. The real problem the operating force will have to face is panic caused by a fire.

Fire in the Holland Tunnels, such as might occur with the burning of an automobile or truck, in itself ought not be dangerous under most conditions, because the transverse method of ventilation should tend to localize the fire and smoke rather than spread them. But fire may mean panic, particularly if the fire is such as might occur in a collision in which gasoline would spill on the roadway and ignite suddenly; and it is with the unknown action of people in such an emergency that the operators of the tunnels will have to deal.

After the ventilating equipment and fire-fighting apparatus are installed, and before the tunnel is open to

traffic, the commission plans to make fire tests approximating, as closely as possible, actual conditions to the end that the police upon whom the responsibility for the prevention of panic will rest may be assured that the ventilating system will care for the smoke and that the fire-fighting apparatus is adequate. If they are confident of their own safety, they can be counted upon to instill confidence in the other people in the tunnel. The results of these preliminary tests may indicate that a definite spacing of vehicles in the tunnel is desirable to reduce the possibility of panic. If so, it can be brought about by balancing the incoming cars against those leaving the exits and by making movements throughout the tunnels corresponding to that at the exits by use of the traffic signals.

Fires may and probably will occur in the tunnels as they do upon the East River bridges at New York, but such fires should not be any more serious than are the fires upon the bridges where the fire-fighting facilities are nowhere near as adequate as they are to be in the vehicular tunnels, and people using the tunnels should not be exposed to any unusual risk through their occurrence.

Politics Eyes the Highway

EVER since road building in this country became something more than a township obligation, the politicians have cast at it an envious eye. No activity in the state comes so close to the citizen. Every home is on or near a state road potential or actual, and every voter can be approached or reached by judicious highway location. The patronage resident in road control is alluring and few single activities of the state require so large an expenditure of funds. All of this is not without its attraction to those seeking or holding office.

In spite of the temptation thus offered, it has been a hopeful fact that during the great road-building years of the past two decades those who gained political control of our states have, as a rule, kept their hands off the road builders. Engineers have congratulated themselves on this tendency both because of selfish advantage they would gain by doing their work without offensive interference and from the altruistic conviction that in so doing the people who pay for and use the roads would be best served. They should not continue to live in a fool's paradise, for there are signs everywhere of a breakdown in this righteous tendency.

It is not to be expected that the governor of a state will keep his hands absolutely clear of the highway department. Highway construction is a large part of the duties of his administration. In many cases the highway policy is a major issue in his election. His interest in the conduct of the department is natural, but that interest can be quite satisfied in the appointment or retention of the proper kind of highway commissioners, where there are commissioners, and the appointment or retention of the proper kind of highway engineer. When he goes beyond that into the dictation of policies, the denomination of routes, and the appointment of subordinates, it can be assumed that his interest lies more in the building up of his own prestige and the establishment of political domination than in the development of the proper road service for the people.

It would be invidious to recount in detail the numerous instances where this particular kind of pernicious activity has been resorted to by a governor, but were all of the cases to be set down the evidence would be overwhelming that the politicians, exhibited as a class by the governors, are more and more attempting to assume dictation of highway policy and control of highway departments with the improper end in view that such dictation necessarily implies.

Reference might be made to Illinois where last year the governor all but wrecked the highway department with his demand for funds from the highway engineers to repay money the court ordered him to reinstate in the treasury. The Texas frauds are still too clear in the minds of all engineers to need recitation. Wisconsin's exhibition of six months ago is significant, particularly the appointment as a highway commissioner of a prominent salesman of supplies to road contractors. In Washington the turbulent governor, Mr. Hartley, has just appointed his own state engineer and has set up for himself a rump highway commission in defiance to the existing commission. In New Jersey a retiring commissioner, one of the leading engineers in the East, has been replaced by a local politician of persistent office-holding history and now the commission, once dominated by this engineer and a famous retired army officer, has the old general as a minority member to two gentlemen of political prominence only. In Oklahoma there is trouble. The state engineer there, a man of excellent reputation and longstanding service, has been dismissed at the instance of the governor who, among other things, is reported to have insisted that the contractors take out their surety bonds from certain individuals and who has replaced certain of the highway inspectors and engineers with political appointees.

There is Maine, too, where a courageous citizen forced the legislature into an open investigation of the governor's control and domination of a highway commission which has been trying to undermine the work of one of the best state highway engineers in the country and where, too, the governor has had the effrontery to appoint as a highway commissioner a man who not only sells equipment and supplies to contractors building the roads, but, it was testified in the legislative hearing, tried to get the state engineer to overmeasure a contract in which the commissioner had a pecuniary interest. This man, with the connivance of the governor, did his best to disorganize the highway department and to favor the contractors as against the state. Fortunately, the evidence of unwarranted gubernatorial interference and of inefficient commissioners was so great that the legislature weakly but certainly rebuked the commission, and the highway engineer came out of the difficulty stronger than before.

These are merely straws in the wind, but they are indications worth noting. Engineers should appreciate what is happening. The people should understand. Throughout the country the politicians are edging into the control of the highways. They have kept their hands fairly clear for some years past. State highway department morale under independent engineering control has been built up to a high level, and the admirable state highway systems are the result. But the politician never sleeps and he thinks the people are becoming quiescent and satisfied. That is always his opportunity. Publicity, and a little courage on the part of the engineers, are the weapons that will be most needed if the highway is to be saved from the spoilsmen.

Studies and Methods Adopted for Ventilating the Holland Vehicular Tunnels

Lack of Information on Amount of Vitiation of Air in Tunnels Leads to Extensive Studies of Motor Exhaust Gas and Effect on Human Beings—Fan System Insures Adequate Air Supply

PROGRESS on the vehicular tunnels being built under the Hudson River at New York has been recorded in "Engineering News-Record" as the work advanced. As the work draws to a close there remain two features of the work which have not been described—the ventilation studies and equipment, and the method of operation. This article deals with the ventilation. What is to be said on that subject is affected by the fact that an article on the ventilation of the Oakland Estuary tunnel, published in our issue of March 10, 1927, p. 392, described work on a similar though much smaller structure whose ventilating system is like that of the Holland tunnels at New York and is based upon the studies and designs developed for the latter tunnels. Some of the general data given in that article which apply to both tunnels will not be repeated here.

ONE of the major problems which faced the engineers of the New York and New Jersey tunnel commissions when they began to design the vehicular tunnels which now extend under the Hudson River from the neighborhood of Canal St. in Manhattan Island to 12th St. in Jersey City, was that of ventilation. Nowhere in the world had vehicular tunnels of similar length been built. Those of shorter lengths which have been in use in Europe for many years were devoted almost exclusively to horsedrawn vehicles prior to the time the studies at New York began and consequently required little or no artificial ventilation. The assurance that the majority of vehicles using the Hudson River tunnels would be motor-driven rendered the little knowledge of ventilating methods that could be obtained from European practice of no value.

Moreover, at the time the studies were begun there was but little information available as to the amount or character of gases given off by motor vehicles nor of the effect of various concentrations of those gases upon human beings. These conditions not only made an elaborate study of ventilation necessary, but also had a direct bearing upon the size and shape of the tunnel section to be adopted. On account of their magnitude, at least the general details of a ventilating system had to be worked out before contracts could be let for driving the underwater portions of the tunnels because the size and shape would depend, in large part, upon the space required for ventilating ducts.

Two general methods of artificial ventilation were available: (1) Longitudinal currents from end to end of the passageway of the tunnel or between vent shafts and (2) transverse ventilation from longitudinal ducts running parallel to the passageway. The former method, that of forcing currents of air through long sections of tunnel much as is done in the ventilation of railroad tunnels, was abandoned for reasons given in detail in the article on the Oakland Estuary tunnel referred to above, chiefly because of the impossibility

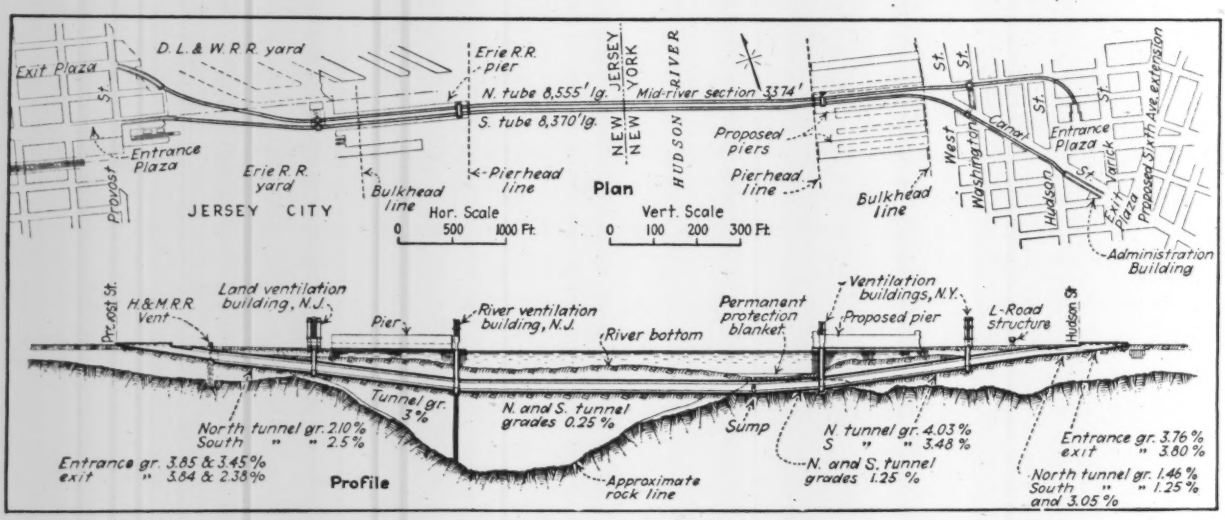


FIG. 1—PLAN AND PROFILE OF THE HOLLAND TUNNELS

of getting a uniform distribution of fresh air by that method and the danger in case of fire in the tunnel.

This left the transverse method as the most desirable, and as it required the use of large ducts for the delivery of fresh air and the removal of vitiated air from the tunnel, a circular section with a fresh air duct below the roadway and an exhaust duct above the roadway was decided upon as being the most economical for the underwater portions of the tunnel (see Fig. 3). The diameter of the cross-section was placed at 29 ft. at that time. Subsequently, the diameter of the greater part of the tunnel was increased to 29 ft. 6 in. to give larger areas for the ventilating ducts. For the north

tube at the New Jersey end where the location of the land shaft to suit conditions in the railway yards overhead made the outer section of that tube unusually long, the diameter was increased to 30 ft. 4 in. to give still larger ducts and to reduce the friction losses. That portion is the largest subaqueous tunnel in the world.

It was in 1919 that the general features were decided upon. Immediately thereafter a contract was entered into with the U. S. Bureau of Mines to make tests to determine the character and amount of poisonous gases given off by motor cars under various conditions of speed and grade, and of the physiological effects of such gases.

Tests on the composition of the gases were begun at the bureau's experiment station at Pittsburgh, Pa., in December, 1919, and completed in September, 1920. While they were in progress other tests to determine the allowable air vitiation were undertaken at the Bureau of Mines station at Yale University. A report of these tests was given in *Engineering News-Record*, April 7, 1921, p. 602.

Exhaust Gas Tests—The tests at Pittsburgh were made upon motor cars and trucks, chosen at random from vehicles in actual service, under both summer and winter conditions. They included all conditions of acceleration, of speeds up to 15 m.p.h., also idling, and on grades up to 3½ per cent, approximately the maximum encountered in the tunnel. The tests showed that, although many gases were given off, carbon monoxide was the only asphyxial gas. The quantity of carbon monoxide given off varied so widely with the type of motor vehicle, carburetor adjustment and method of control that no average figure for all types and conditions of practical value can be given. However, the quantity of carbon monoxide in cubic feet per car per minute given off in the great majority of cases was between 0.57 and 2.80 at normal speeds. The amount of carbon monoxide produced per minute with engine idling was found to be smaller than for running conditions, indicating that when cars closed up in a blockade the air requirements will be no more than for normal operation.

Dilution Tests—The tests undertaken at Yale to determine the effect of automobile gases upon persons using the tunnel were directed toward establishing the amount of carbon monoxide that may be absorbed without harmful effect, the rate of absorption, and whether the susceptibility to monoxide poisoning varies in different individuals, also, whether other toxic gases were given off by gasoline engines. Tests were made upon persons in closed rooms with concentration of carbon monoxide gas of from 2 to 10 parts in 10,000, also upon a large number of persons in a closed room into which an automobile engine was exhausting. Test periods were 1 hr. long, or twice the time required to pass through the tunnel at a rate 3 miles per hour.

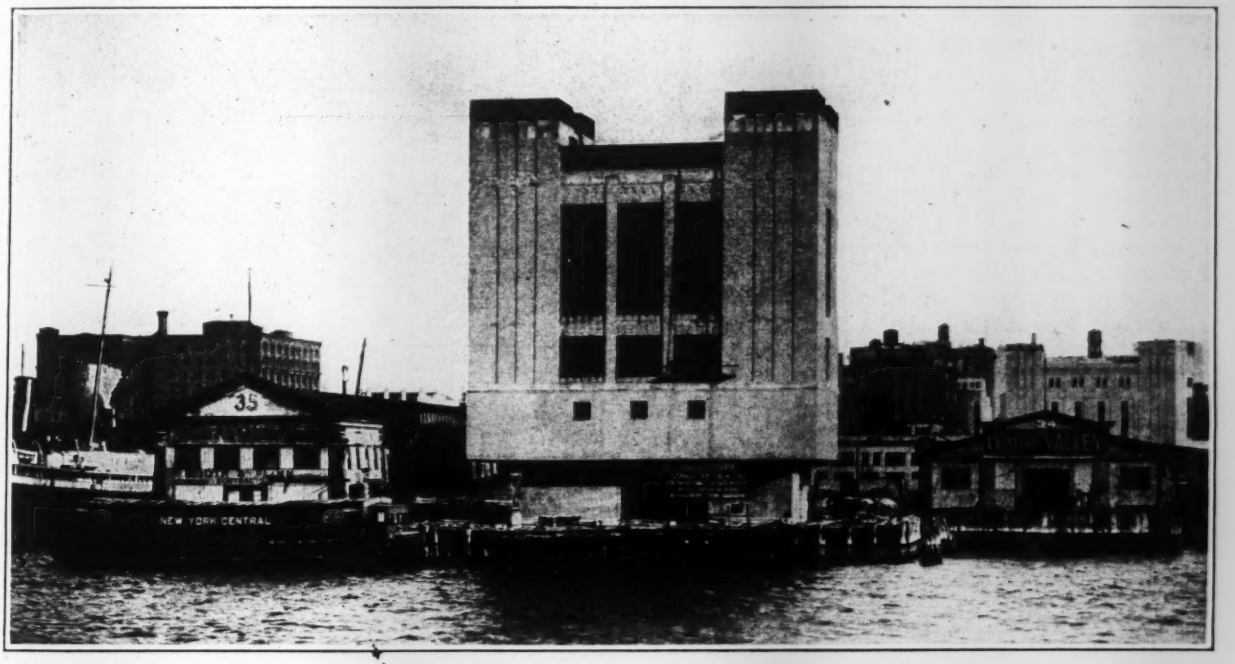


FIG. 2—PIERHEAD VENTILATING BUILDING, NEW YORK
Fresh air is taken in through the louvres in the sides of the building. Vitiated air is exhausted through the corner towers. The land ventilating building is in the right background.

The results of these tests showed that exhaust gases of gasoline engines contain no appreciable amount of poisonous substances other than carbon monoxide, although the smoke from improper combustion is irritating to the eyes and nauseating to some people. No variation in susceptibility was found. Mild concentrations of carbon monoxide have no noticeable or harmful effects; greater concentrations cause headache which disappears upon going out into fresh air. Concentrations up to 4 parts in 10,000 for 1 hr. cause no ill effects, 6 parts are slightly noticeable, and 8 or 10 parts have a marked effect. Actual danger does not begin until much greater concentrations are reached. As a result of these tests a maximum concentration of 4 parts in 10,000 was selected as a criterion in design of the ventilating equipment.

Air Requirements—The estimated capacity of the 20-ft. roadway in each tunnel is 1,900 vehicles per hour, but for purposes of estimating the air requirements

this figure was raised to 2,113. For such maximum traffic the following amounts of fresh air were found to be required: 295 cu.ft. per min. per foot of upgrade, 125 cu.ft. for downgrade, and 225 cu.ft. for level grade. These amounts gave a total of 1,919,982 cu.ft. per minute for the north tube and 1,841,456 cu.ft. for the south tube. A supply of this quantity of air will give an average of 42 changes per hour in the tubes.

Further Tests—While these tests on the character of exhaust gases and air requirements were in progress, a third series of experiments was being undertaken at the University of Illinois to determine the power required to move air through concrete ducts similar to those to be used in the vehicular tunnel, also the size and shape of exhaust and inlet ports, exhaust stacks and intake louvres.

Upon the completion of the three sets of experiments a final test was determined upon. It consisted in operating a tunnel in the experimental mine of the Bureau of Mines at Bruceton, Pa., in which the results of the previous experiments could be put into actual practice. A tunnel of cross-section about one-third that of the Holland Tunnel and 400 ft. long was constructed. Automobiles were operated in it for 1-hr. periods while tests upon the air conditions and the automobile operators were carried on. These tests confirmed earlier conclusions of the engineers on several points, including the very important one that the fresh air should be supplied close to the roadway level and the vitiated air drawn off from the top.

Ventilating Equipment—The location of the ventilating buildings and shafts is shown in Fig. 1. Two are at the pierhead line and two are inland, one between the two tunnels on Washington St. in New York City and the other north of the tunnels in the Erie R.R. yard in Jersey City.

Each land shaft ventilates four sections of tunnel, the adjoining portal sections of each tube, the whole intermediate section to the pierhead shaft where traffic is on a downgrade and one-half of the parallel section where it is on an upgrade. The buildings over these

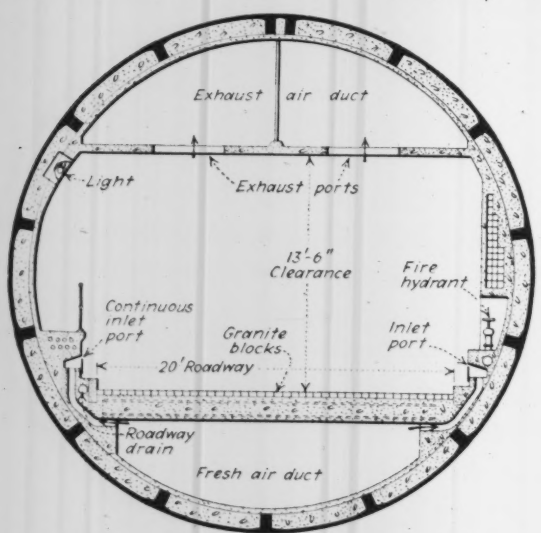


FIG. 3—CROSS-SECTION OF ONE TUNNEL

shafts contain four independent sets of blower and exhaust fans. The pierhead shafts ventilate three sections of tunnel, one-half of each of the 3,400-ft. river sections and one-half of the intermediate section where traffic is on the upgrade. In all there are 14 sets of blowers and 14 sets of exhaust fans. Dividing the upgrade sections of the tunnels into three parts gives added ventilation where the greatest amount of carbon monoxide is expected.

There are 28 ducts, 14 blower and 14 exhaust, connecting the various sections of the tunnels with the ventilating buildings. Each duct is equipped with three fans, two of which, when operated together, will supply the maximum quantity of air required. This gives standby equipment with a capacity of a little over half the required supply even if two fans of any duct should be disabled at the same time. There are 84 fans in all. Their capacities range from 81,000 to 227,000 cu.ft. per min. and they operate at static pressures varying from 0.6 to 3.75 in. of water. This range in pressure and capacity is due to the great difference in length of tunnel ventilated by different sets, those at the outside of the pierhead shafts having 1,700 ft. to serve while the inside fans have only 700 or 800 ft.

The fans are of the backward curved blade type, a type which can be operated in parallel. They are to be

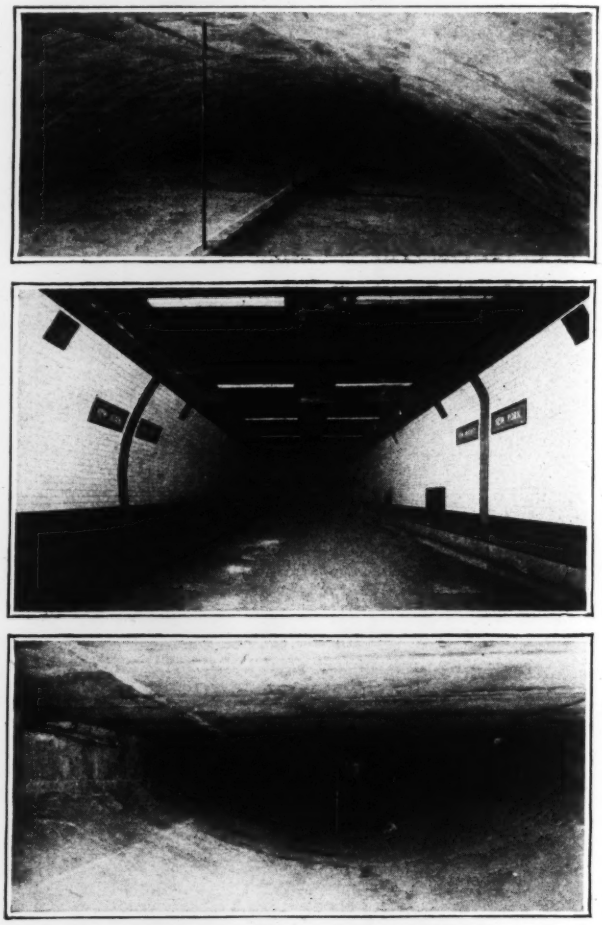


FIG. 4—INTERIOR OF NORTH TUNNEL

Above: The exhaust duct over the roadway. Center: The roadway. Continuous fresh-air port shows as a black line midway between the curb and walk on the left; similarly on the right. Exhaust ports may be seen in the ceiling which had not been painted when this picture was taken. Below: The fresh air duct under the roadway. The small outlet ducts may be seen at both sides.

electrically driven by wound-rotor motors with resistance in the circuit to make it possible to run them at variable speeds. The combined capacities of the motors is approximately 6,000 hp., two-thirds of which will be in operation at times of maximum load and one-third in reserve. Chain drives are to be used to make possible speed adjustments or changes in the motors as well as on account of the space limitations in the ventilating buildings.

A typical arrangement of fans in one of the ventilating buildings is shown in Fig. 6. The placing of the fans is varied to suit the local conditions in the individual buildings. Generally, the exhaust ducts are at the corners of the buildings and supply ducts are in the central portion. Consequently the compartments containing the exhaust fans are located near the corners under the exhaust stacks leaving the central portions of the fan floors free for intake fans, and the central section of each outer wall for the air intakes. The intakes are made sufficiently large to give low velocities through the louvres.

The louvre blades are made of heavy wire glass to give light to the interior of the buildings as they take up most of the space otherwise available for windows. They are 8 in. wide, set at an angle of 45 deg. and spaced 5½ in. apart. Heavy bronze screens protect them and also serve to keep out birds.

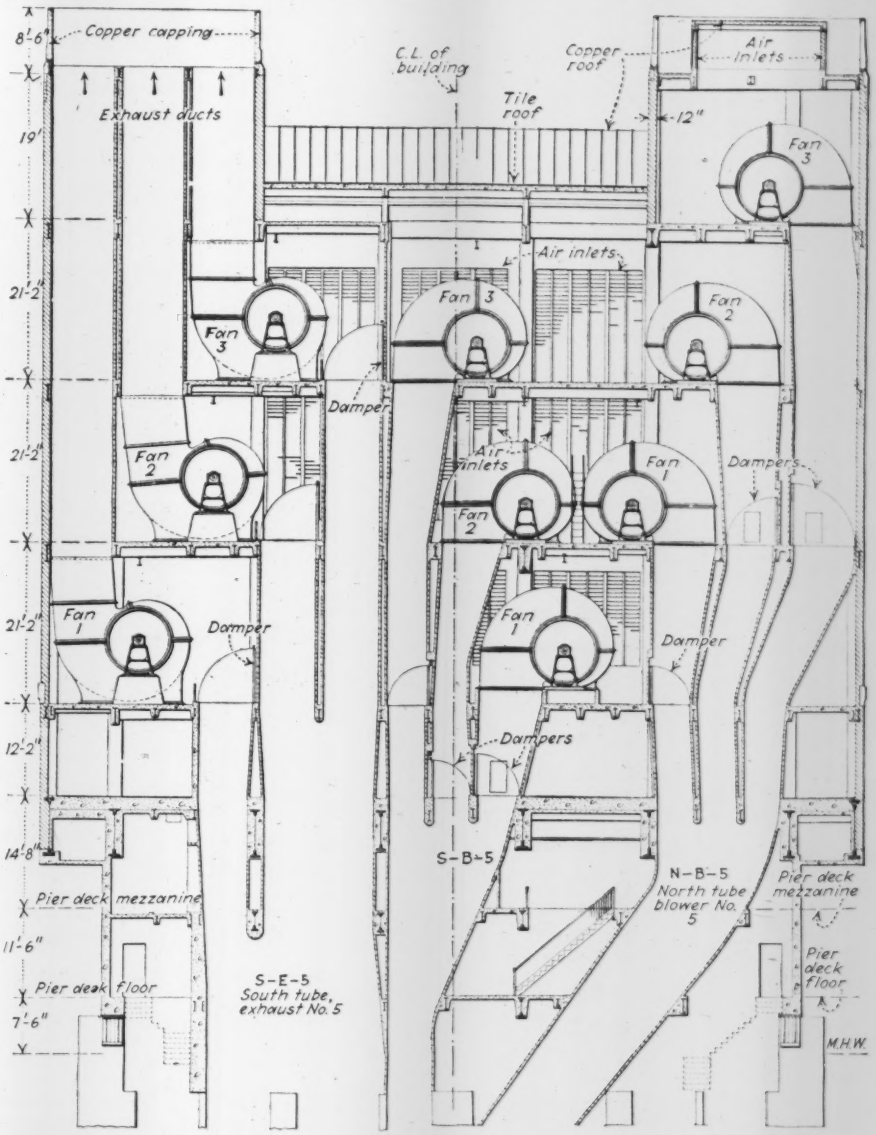


FIG. 6—TYPICAL VERTICAL SECTION THROUGH VENTILATING BUILDING

FIG. 5—BOTTOM OF A BLOWER DUCT
Ducts from three fans combined to form one duct to the tunnel.

The arrangement whereby fresh air is drawn in through louvres high up on the sides of the buildings and exhaust air is forced out through stacks which extend 20 ft. above the roof insures a complete separation of fresh and vitiated air.

The vitiated air stacks are open at the top and are provided with drains at the bottom of the fans to carry off rain water. Snow will be blown out. Open tops were considered to be better than any form of hood which would increase the resistance to flow and deflect the vitiated air down toward the intakes.

The intake fans and their motors are situated in the open portions of the fan floors where they are accessible, Fig. 7. The exhaust fans are, of necessity, inside of chambers at the top of the ducts. Their motors, however, are out on the main floor, the drive shafts being run in to the fans through close-fitting collars in the side plates of the duct, Fig. 8. Access to the fans is provided through air locks equipped with airtight

doors which can be opened against the unequal pressure by wedge latches which force the doors open sufficiently to break the seal.

Each duct is equipped with a damper which may be closed when the fan is shut down so that air from the other fans will not be short-circuited through the idle fan. These dampers are motor operated from the control room and are equipped with limit switches.

Maintenance—Every precaution has been taken to insure speedy repair work. No fan or motor has been

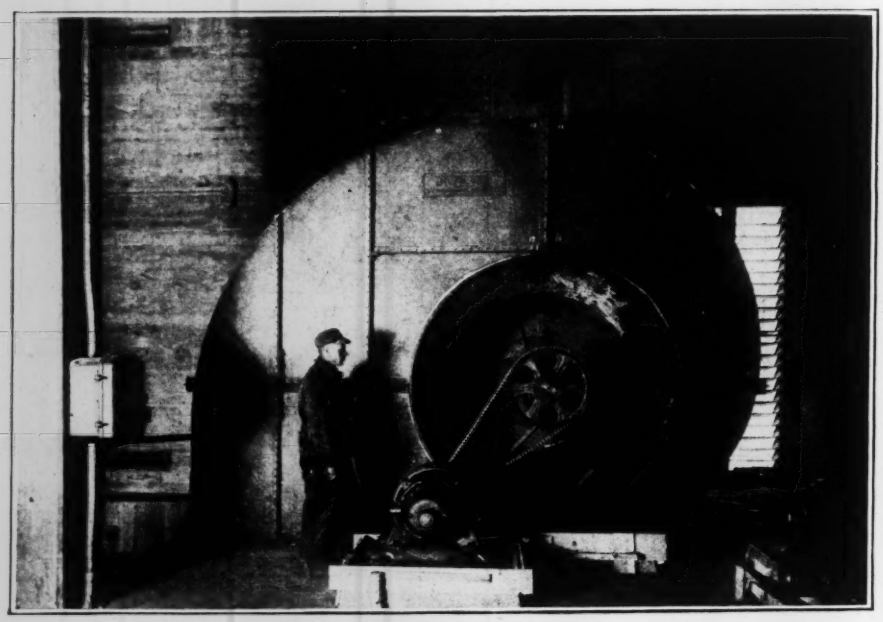


FIG. 7—TYPICAL BLOWER FAN

One of the air inlet louvres beyond the fan. Fan control switch at left. The chain drive is to be housed as shown in Fig. 8. Trolley beam for hoist is over the center of the fan.

so built that it cannot be taken out. The sides of the ducts which generally are of cast concrete or gunite on heavy reinforcing mesh, are made of bolted steel plates where they adjoin the exhaust fans so that the fans can be removed without having to stop to cut out a concrete wall. Fan casings are specially designed to facilitate removal of the fans. Trolley rails extend from a central hoist shaft to a point over each heavy piece of machinery. All machinery supports are arranged so that they can be disconnected from their concrete bases without having to cut out grouted beds.

All structural steel in the ventilating buildings except in the fans, access diaphragms and larger dampers is encased in concrete. The fans, diaphragms and dampers are to be heavily painted and are accessible for inspection. The exhaust port slides in the tunnel are of zinc and the exhaust ports are covered with bronze screens. Thin sides of ducts are made of gunite on heavy reinforcing mesh.

Power Supply—An unusually flexible system of power supply has been worked out based on the facts that all the motors are in groups of three, also that the maximum power equipments are less than the capacity of the minimum size power cables installed by the local companies. Three cables from the New York side and three from the New Jersey side are run to the bus bars in each ventilating building thus giving one motor in each set a separate cable connection to power supply on each side of the river. Interconnection at the bus bars makes it possible to cut in any or all motors on each cable. Thus connected, each motor may be supplied with power by six independent cables each capable of carrying the entire tunnel load; and, as there are at least two independent sources of power at each end of the tunnel, continuity of power supply is absolutely assured.

As the transformers are located in the ventilating buildings where smoke from an oil fire might be drawn into the ventilating system, air-cooled instead of oil-cooled transformers are used.

Fan Control—Each fan is provided with a control switch at the motor for emergency or repair use (see Fig. 7); further local control is provided at the switchboard in each ventilating building, and complete operating control is provided at the main switchboard in the administration building where, by a system of signal lights, it will be possible, at all times, to tell what motors are in operation.

Distribution of Air—Air from the intake fans is forced down into the longitudinal duct under the roadway of the tunnel shown in Fig. 3, also in Fig. 4. From there it is fed through flues 10 to 15 ft. apart into a continuous expansion chamber above the curb line at each side of the roadway, the flow of air into this chamber being controlled by adjustable slides over the flue openings. The outer side of the expansion chamber is a copper-steel plate which can be adjusted to give an opening of widths varying from $\frac{3}{4}$ in. to $1\frac{3}{4}$ in. through which fresh air flows into the tunnel.

Vitiated air is drawn off through openings through

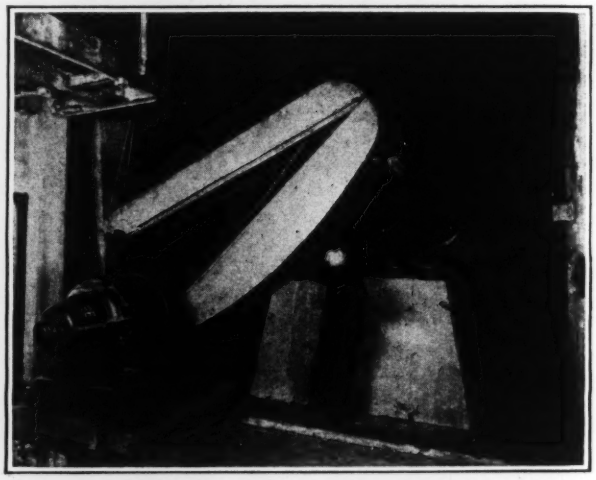


FIG. 8—EXHAUST FAN WITH CHAIN CASING OPEN

Motors of the exhaust fans are placed outside the fan room. The frame for the steel diaphragm closing off the room can be seen at the two sides and the foreground. The connection between the fan and the duct above was not made when picture was taken.

the ceiling into the exhaust ducts. These openings are spaced 10 to 15 ft. apart and are from 3 to 6 ft. long. They, also, are provided with slides by which the opening can be adjusted to meet the local requirements for air circulation.

By this arrangement of supply and exhaust ports, fresh air supplied to the roadway mixes with the warmer gases and rises to the ceiling where the exhaust ports are located.

There will be no longitudinal movement of air in the tunnels except that induced by the movement of vehicles, nor will there be any objectionable winds such as would be created by longitudinal ventilation. Tests made with smoke bombs showed that even large quantities of smoke will not spread far from the point of origin, but will rise quickly to the ceiling and be taken out. Similarly, in case of a fire the hot gases will rise to the ceiling where they will be drawn off. There will not be

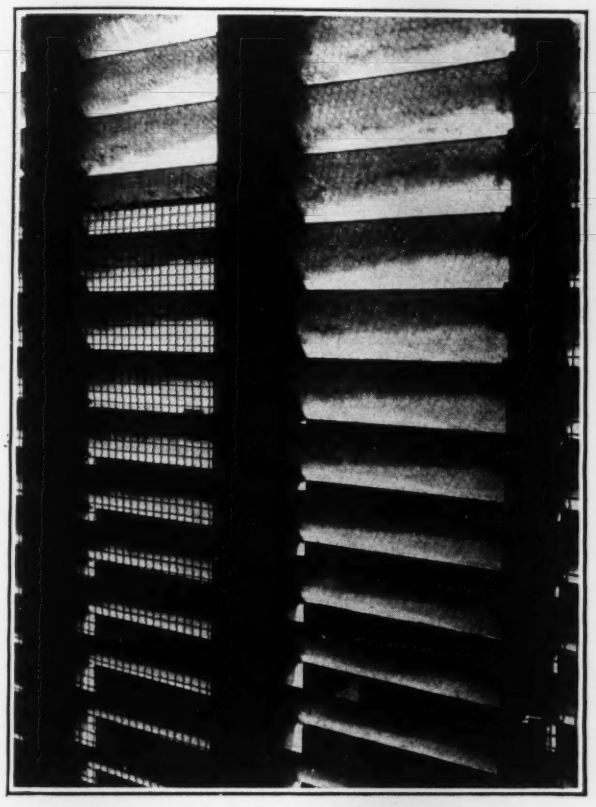


FIG. 9—DETAILS OF THE AIR INTAKE LOUVRES
The louvre blades are of wire glass protected by bronze screens.

the same danger of spreading the fire from car to car that there would be with longitudinal ventilation.

Fire Tests—As part of the studies for the ventilating equipment numerous tests in relation to fire were made both in the test tunnel at Bruceton and at the laboratories of manufacturers of fire-fighting equipment. These tests included the burning of an automobile drenched with gasoline and with gasoline spilling from a hole in the tank on the car to determine how quickly such a fire could be put out with the hand extinguishers to be placed in the tunnel. As soon as the ventilating equipment of the tunnel is in operating condition and the fire-fighting apparatus is available a similar test will be made in the tunnel along with other tests for the final adjustment of the ventilating equipment.

Ventilation Control—As a check upon the air conditions in the tunnel, automatic carbon-monoxide recording devices are to be installed in each exhaust duct which will make a continuous analysis of the gases and record it graphically in the control room of the administration

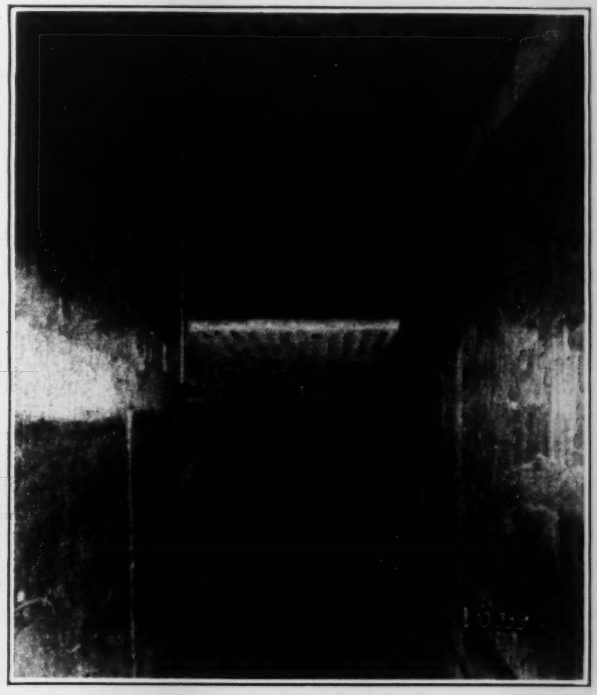


FIG. 10—INTERIOR OF AN AIR DUCT
End of transition where duct has completed turning from under the roadway to a position at the side of the tunnel, the position occupied in the rectangular portions of the tunnel.

building in New York. There, by observing the chart, the operator can increase or decrease the fresh air supply as traffic conditions change in the tunnel.

Personnel—The ventilation work has been carried on along with the other engineering work of the commissions, first under the general direction of the late Clifford M. Holland, then under his successor, the late Milton H. Freeman, and since March, 1925, under the present chief engineer Ole Singstad. The ventilation plan and the program for the research work in connection therewith were developed under the direction of Ole Singstad, formerly engineer of designs. The ventilating equipment is being installed under the direction of Ralph Smillie, the present engineer of designs, A. C. Davis, mechanical engineer, and J. N. Dodd, electrical engineer. The tests at Pittsburgh were carried out under the direction of A. C. Fieldner, supervising chemist of the Bureau of Mines; those at Yale University under Yandell Henderson, consulting physiologist to the Bureau; and those at the University of Illinois under Prof. A. C. Willard, consultant on ventilation. L. B. Stillwell is electrical consultant.

Construction of the ventilating building is being carried out under contract with the De Riso Construction Co. and the fan and motors are being installed by the B. F. Sturtevant Co. and the General Electric Co. respectively.

Block Stone Base for Asphalt Road, New South Wales

Hand Placed Foundation on Sub-Base of Cinders with Tile Underdrains—Cross-Section Designed for Future Widening

By R. W. Parkhurst
Barber Asphalt Co., Sydney, New South Wales

FIRST of its type, in an extensive program of road construction, in which the state of New South Wales embarked some time ago, Forest Road, Hurstville, presents features which distinguish it from many roads in Australia and bring it into line with present American practice. The work comprises about 24,000 sq.yd. of completed surface, and was carred out under the supervision of the Main Roads Board at a total cost of $115,000, including excavation, curbing, drainage, etc.

An exceptionally heavy foundation, composed of blocks of sandstone between 15x17x9-in. and 9x3x6-in. size, carefully packed by hand and laid upon 3 in. of rolled cinders, formed the base of the road. This was filled with coarse sand and rolled. Over this was laid a course of stone, filled with ½-in. screenings, and 2 in. in minimum thickness after consolidation. On account of the spongy, clay subsoil, a complete system of 4-in. under-drains was laid to connect with the existing storm-water drains.

Unlike many roads which hitherto have been built in Australia, the wearing-surface of Forest Road was a close-graded asphaltic concrete, essentially of the

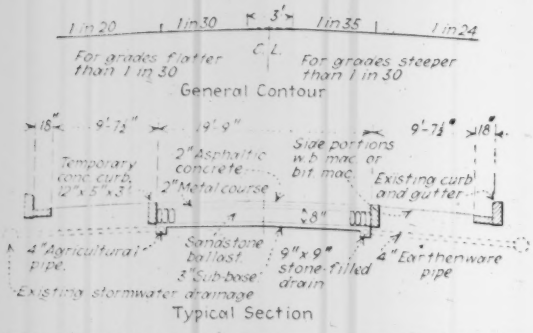


FIG. 1—TYPICAL CROSS-SECTION OF NEW SOUTH WALES ROAD

Topeka type but with somewhat larger aggregate, laid without seal-coat. The approximate composition is:

Material	Per Cent
Bitumen (Trinidad A.C. 46-50 penetration)	6.0- 7.0
Filler passing 200-mesh screen	9.5-10.5
Aggregate passing 10-mesh screen	40.0-42.0
Aggregate passing ¼-in., ½-in. and ¾-in. screens	40.0-43.0

This mixture was handled in the usual manner, and rolled with 8-ton tandem rollers to a finished minimum thickness of 2 in. Owing to the fact that relatively little high-grade asphalt work has been done in Australia, some difficulty in securing competent labor was experienced. However, a maximum output of 1,200 sq.yd. in 10 hours and a daily average for the entire job of 700 sq.yd. was secured. The contractor's plant was of 800-sq.yd. capacity, equipped with a 1,000-lb. batch mixer and three fire-heated melting kettles of 1,000-gal. capacity each, provided with mechanical agitation to ensure proper fluxing.

With the materials and labor available, experience has proved the necessity of observing every possible precaution to ensure uniformity of output. Careful checks on material gradings were maintained throughout the entire job, both of the stock supplies and the heated aggregate as it was delivered at the mixer. An extraction test of a sample from each day's section of completed road was also made as a final check of the quality of the asphaltic mixture.

The asphaltic concrete surface was laid to a width of 19 ft. 9 in. between temporary precast concrete curbs, 5x12 in. in section and 3 ft. long. At a later date, these are to be removed and the asphaltic concrete extended to the permanent concrete gutter, giving a final road

FIG. 2—LAYING STONE BASE FOR ASPHALT ROAD

width of 39 ft. Meanwhile, in the business section of Hurstville the shoulders have been surfaced with 2 in. of asphalt penetration, or protected with ordinary macadam.

Plans and specifications for the work were prepared by S. L. Luker, consulting engineer for the municipality of Hurstville. Members of the Main Roads Board of New South Wales in supervisory charge were: John Garlick, chairman; H. H. Newell and T. H. Upton. The contractor for the work was The Neuchatel Asphalt Co., Ltd., of Sydney.

It may be noted that the Main Roads Board of New South Wales, a department created by the state in January, 1925, is charged with construction and maintenance of the state main roads system, which comprises 579 miles in the county of Cumberland (Sydney metropolitan area) and 12,261 miles in the country districts. Roads of all types are included in this total, earth, gravel and macadam predominating in the country districts and higher types such as asphaltic concrete, wood-block, cement concrete, surface-treated macadam and penetration asphalt in the county of Cumberland.

Cuba Highway Surfacing and Concrete Mix

In the article on the Central Highway in Cuba, Apr. 7, 1927, p. 558, the section of the highway shown there indicates the concrete sub-base as being a 1:2½:3 concrete. This should be 1:2½:5, as is indicated in the text of the article. Furthermore, the surface of the highway is asphaltic concrete although that is not indicated in the drawing. The text also is correct in this respect.

Proportioning Steel Slabs for Column Bases

Divergent Practice as to Thickness—The Question of Unit Stress—Recorded Tests Are Not Adequate

By R. Fleming
Structural Engineer, American Bridge Co., New York

SINCE the use of rolled steel slabs, with or without grillage beams, for column footings is becoming more and more common a review of the subject may not be out of place. The advantages of their use are apparent. Complicated details at column bases are avoided. A saving is effected in the depth of excavation required, and if the excavation is in rock the saving may be enough to warrant a slab of considerably greater weight than a tier of grillage beams.

The problem at once presents itself: How shall the thickness of the slab be determined? The required area is easily found by dividing the load to be carried by the allowable average bearing pressure on the material beneath. For purposes of illustration, a load of 1,000 thousands of pounds will be assumed to be carried by a rolled steel slab that rests on a bed of concrete. It is understood that the calculated thicknesses are those after planing, also that the shaft of the column is anchored to the slab by lug angles and bolts. The allowable pressure on the concrete will be assumed at 500 lb. per sq.in.

According to the "Tables Governing Design of Structural Steel in Tier Buildings" of the American Bridge Co., the slab required for a base is 44x46x5 in. According to the tables of "Rolled Steel Slabs for Column Bases Manufactured by Bethlehem Steel Co.," a 14-in. H-column under the same conditions requires a slab 44x45x5 in. The maximum stress in bending is given as 16,000 lb. per sq.in. in the American Bridge Co. tables and as 18,000 lb. in the Bethlehem tables. Neither set of tables gives the method by which thicknesses are derived.

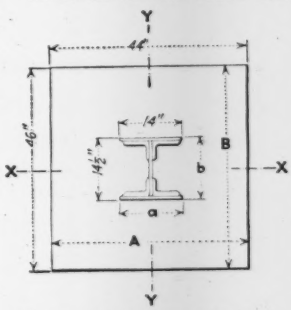
The area required is 2,000 sq.in. A slab 44x46 in. will be considered. Turning to the familiar Carnegie "Pocket Companion," the thickness of the slab is determined from the maximum bending moment about the plane of fracture through the axis $X\,X$ or $Y\,Y$ passing through the center of the column. The basic formula is fI/c. The notation is so well known that it need not be repeated. If W is the total load in pounds, $M = \frac{W(A-a)}{8}$ or $\frac{W(B-b)}{8}$. Solving for the illustration given, with a unit-stress of 16,000 lb. per sq.in., the thickness is found equal to 5.53 or 5.79. If a stress of 18,000 is used the required thickness is 5.46 in., so that using the greater fiber stress decreases the theoretical thickness only 6 per cent.

The Carnegie method, though on the side of safety, is needlessly severe. Moreover, the equation used is correct only when the pressure on the upper surface remains uniformly distributed over the area $a \times b$. If the superimposed load is applied through an ordinary column shaft the line about which the slab tends to bend is shifted from the center toward the edges because the load is not distributed but concentrated under the metal of the column shaft section.

The American Institute of Steel Construction in its handbook "Steel Construction" under "Solid Steel Bases for Columns: Data to Determine Thickness" assumes the column load to be concentrated on the four corners of the column, "the web area being practically relieved of pressure by the dish or saucer-like action of the slab. These corners constitute 60 to 75 per cent of the column area, so that this assumption does not produce a bearing stress in any case equal to the allowable pressure of metal upon metal. For H-columns, plate and angle columns, and plate, angle and coverplated columns, the average effective dimensions are 0.90 of the column depth, and 0.55 of the column width. The determining bending moment will occur along the inner line of these projections and will be maximum for the greater projection."

For the slab and column under consideration, at 18,000 lb. per sq.in., the thickness for the minimum projection is 4.75 in. and for the maximum projection, which determines the thickness of the slab, is 5.24 in.

In some of the older formulas it is assumed that the line of fracture or of maximum moment is a straight line tangent to the exterior of the column standing on the plate. This cannot be true because the shear cannot pass through zero at the edge of the column, though (assuming a high stress pressure concentration) it may be near the exterior.



STEEL SLAB SUPPORTING A-COLUMN

In the older editions of Kidder's "Architects' and Builders' Pocket-Book" some empirical formulas are given in Chapter XIII: "Proportions of Cast-iron and Steel Bearing-plates," without stating reasons for using them. This same chapter rewritten for the 17th edition of the Kidder-Nolan Handbook gives a formula that need not be quoted because it is radically wrong. According to this formula the case illustrated requires a slab 9.65 in. thick.

Eugene W. Stern in an article, "Multiple Steel Slabs for Large Column Bases" (*Engineering News-Record*, April 27, 1922), advocates the use of layers of rolled steel slabs, one on top of the other, in place of grillage beams for heavy column loads. He shows a column with a load of 3,400 thousands of pounds on three layers of slabs: 38x38x6 in., 58x58x6 in. and 82x82x5½ in., respectively. "As regards the methods of calculation," he naïvely writes, "I will leave this to the mathematical experts to enlighten us." However, Mr. Stern's method is not practicable. The slabs are the first steel material wanted and when of unusual size they can be procured if at all only with considerable delay. Such would be the case with his 82x82x5½-in. slab.

David C. Coyle in an article, "Some Remarks on Column Footings" (*Engineering News-Record*, June 26, 1924), proposes to show that the uneven distribution of the load under an H-column justifies the use of the moment $\frac{1}{6}W(A-a)$ instead of the Carnegie $\frac{1}{8}W(A-a)$. He is not far wrong; $\frac{1}{12}M = W(B-b)$ could also be used for bending about the plane of fracture parallel to axis $Y\,Y$. With these assumptions and a 16,000-lb. stress a 4.95-in. slab is required. If bending about a plane parallel to $X\,X$ were alone considered,

a thickness of 4.74 in. would be sufficient. If the slab were 43x47 in. the required thicknesses for each plane of fracture would be the same: 4.81 in. and 4.86 in.

It might be supposed that in the literature on reinforced-concrete footings a solution of the problem of designing rolled-steel slabs could be found. But such is not the case. The conditions are not the same, though much of what Professor Talbot says in his monograph, "Reinforced-Concrete Wall Footings and Column Footings" (*Bulletin* 67, March, 1913, Engineering Experiment Station, University of Illinois), is applicable to steel slabs. He will be quoted: "A full treatment would include a consideration of the effect produced by having stresses act at right angles to each other and of the action of other combined stresses. . . . In view of the complexity of the problem and the uncertainty of portions of the work, it seems futile to attempt to derive thoroughly rational formulas for stresses in column footings. . . . The requirement of uniform load and the presence of double-curved flexure complicate an investigation of column footings."

The problem of the distribution of stresses in the saucer-shaped form that slabs would take under a column load is not adapted to direct practical solution. In some slabs which the writer recently proportioned, carrying unusually heavy columns, he assumed the plane of fracture parallel to the web of the column to be at a distance of 80 per cent from the center of the column to its edge parallel to the axis *Y Y*, and the plane of fracture normal to the web of the column to be at a distance of 95 per cent from the center of the column to its edge parallel to the axis *X X*. This is in accordance with the method suggested by a colleague, B. B. Priest, and was used in determining thicknesses in the Tables of Slabs of the American Bridge Co. Of course the method is empirical. The real problem in the case illustrated is to proportion the slab so as not to overstress the concrete on the shaft of the column; the slab itself will not fail. Under the shaft of the column the concrete is more confined than at the edges of the slab and therefore in that area will withstand a greater pressure than farther away. The uneven distribution of the stress in the shaft of the column by the shifting of the plane of bending brings a greater compressive stress in the edges. As this stress will be at a short distance from the slab to be redistributed it is believed that 20,000 or 24,000 lb. per sq.in. will work no injury.

Regarding unit stresses, preference is given to the same values as used elsewhere in the structure, even though it does not accord with experiments to use the same bending stress for steel 3 in. thick as for metal $\frac{3}{8}$ in. thick. However, with due consideration of the distribution of stresses in the concrete and in the column, but little objection can be raised.

With the increasing use of rolled-steel slabs it may be hoped that tests will be made to determine their value more accurately. An interesting question at once arises: How shall these tests be made? No suggestions are offered in this article, but attention is called to two series of tests made at the University of Illinois Experiment Station. In the tests described in "A Study of Base and Bearing Plates for Columns and Beams" by Professor N. Clifford Ricker (*Bulletin* 35, July, 1909), a cushion of eleven layers of 3x$\frac{3}{4}$-in. oak pieces piled in crosswise layers was finally adopted to distribute uniformly the pressure of a 20x20-in. plate over the very rigid bed of the testing machine. The column footings of Professor Talbot mentioned in *Bulletin* 67, March, 1913, were tested in a machine built for that purpose. The test footing was placed on a cushion of 113 car springs (later increased to 225) which in turn rested on a bed of 10-in. I-beams placed side by side with the edges of the flanges touching.

Construction Procedure on Two Arc-Welded Buildings

All Fabrication Done in Field with Connections Originally Designed for Arc Welding—Saving Over Like Riveted Design

By A. G. Bissell
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

TWO ELECTRICALLY welded steel-frame buildings were recently erected at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., at a cost less than the amount estimated and allotted for the erection by riveting. Both buildings were located near offices and for this reason the elimination of noise from rivet hammers proved advantageous. All connections in the building were designed especially for arc welding, mainly without clip angles and gusset plates.

The first building, shown in Fig. 1, was 40x60 ft., the

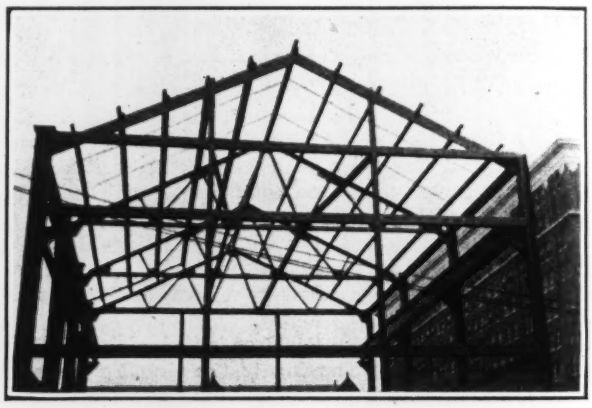


FIG. 1—ARC-WELDED STEEL-FRAME BUILDING WITH 20-TON CRANE TRACK

lower chord of the roof trusses being about 40 ft. above the ground. The steel frame consisted of 12 H-columns joined by three sets of struts carrying the sash, brick walls, cornice and a portion of the roof. The roof is carried by three salvaged riveted trusses cut and welded to fit and one false truss of 12-in. channels. Purlins are 10-in. I-beams. A 24-in. I-beam runs the length of the building on each side, supporting rails for a 20-ton crane. The building contains 115,800 lb. of steel including the three trusses, and was erected for 11.7 per cent less than the architect's estimated cost for riveting.

The second building operation was for an addition to the chemical laboratories, and comprised raising the present building from two to three stories and erecting a three-story extension. A total of 70,000 lb. of steel was used and a saving of 11.4 per cent was made in this building over the riveted cost estimate. The construction procedure developed in erecting both of these buildings proved entirely satisfactory.

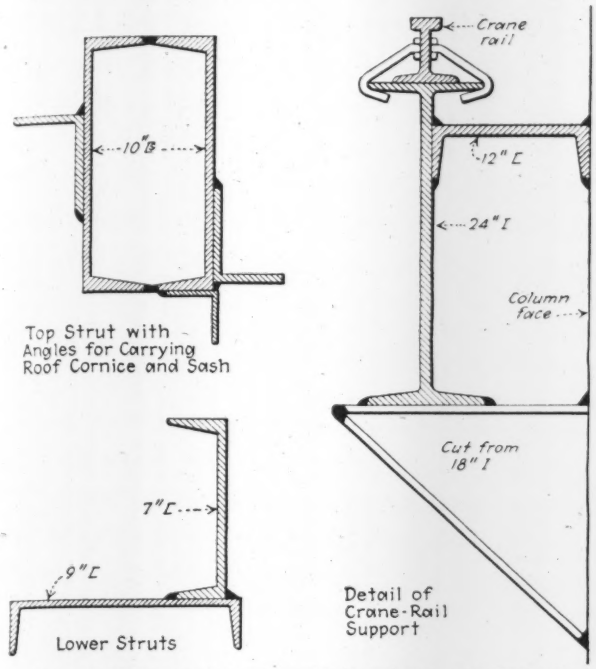


FIG. 2—FABRICATION DETAILS USED ON ARC-WELDED BUILDING

The initial step in erecting the first building was to place the 12 columns and connect them by a set of struts. The three roof trusses were then placed and held in position by four purlins. All these erection connections were bolted, but from this point on no bolts were used. The columns were plumbed by the windbracing rods and by cables and turnbuckles before any welding was done. The trusses were then welded to their brackets and the remaining struts placed. As each strut was landed it was held in place with a 12-in. carriage clamp until welded.

All fabrication was done on the job; the steel therefore could be delivered direct from the mill. The struts connecting the tops of the columns were built of two 10-in. channels attached to each other at the tip of their flanges by tack welds 2 in. long at 12-in. centers. This made a light but strong hollow beam. The lower struts were constructed of 7- and 9-in. channels, the vertical member being attached to the horizontal member by 2-in. tack welds on the heel and toe of its flange. These tacks were spaced 24 in. apart and staggered on each side. The crane brackets were made of sections of 18-in. 70-lb. I-beams and the crane girder was a 24-in. 73-lb. I with a 12-in. 20.7-lb. channel attached to its web as a stiffener and as a means for attaching it to the columns. These details are shown in Fig. 2. The roof truss brackets were cut from 15-in. 45-lb. I-beams. To locate the purlins on the roof trusses, a small piece of $\frac{1}{4}$x1-in. bar was tacked to the upper chords at proper locations. Then one welder was able to secure the purlins as fast as a gang of steel workers could place them.

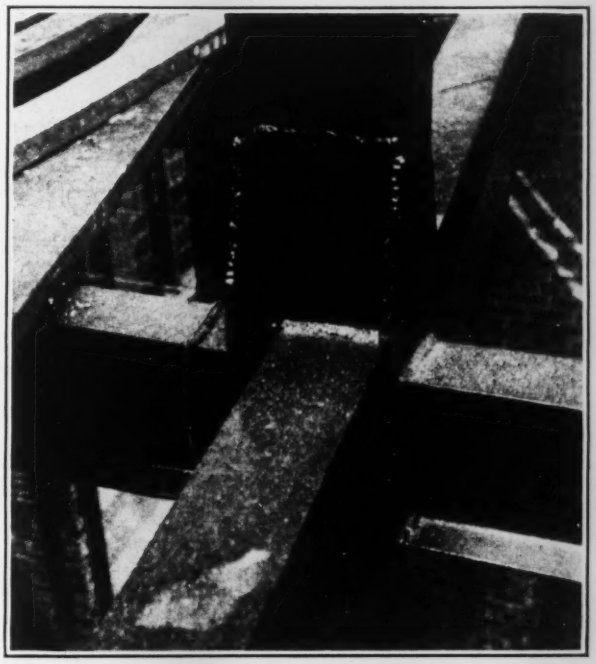


FIG. 4—COLUMN EXTENSION FROM 8-IN. H TO 8-IN. I

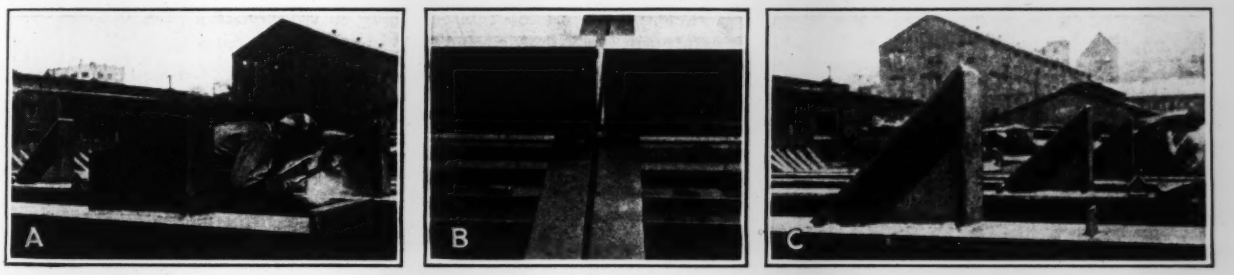


FIG. 3—CONNECTIONS USED ON ARC-WELDED STEEL STRUCTURE
A—Roof bracket. B—Purlin connection to roof truss. C—Crane bracket and landing angle for strut.

The second building, the addition to the chemical laboratory, was erected without the use of either bolts or seat angles. After the 8-in. H-columns were secured to the foundation bolts and plumbed, a post of the required height was placed against this column. On this post was landed one end of the floorbeam, the other end being supported by the wall brickwork. The floorbeam was checked for alignment and secured to the column by four tack welds. The post was then moved to the opposite side and another beam located and tacked. When all members for the second floor were in place, the welder finished the work by running a bead around the entire joint. The brickwork was extended to the next floor and the process repeated.

Since one story was to be added to the present building, it was necessary to extend the original columns. This was done by removing the roof material, exposing the caps on the old 8-in. H-column and butt welding an 8-in. I to it.

Efficiency of Chlorinating Sewage Tank Effluents

Studies at Huntington, N. Y., Show Practicability of Chlorination and Advantages of Control by Orthotolidin Test for Residual Chlorine

By W. V. D. Tiedeman
Division of Sanitation, New York State Department of Health, Albany, N. Y.

SMALL sewage treatment plants are notoriously neglected while even some of the larger plants are poorly operated. In view of the fact that these plants were built for a definite purpose and at considerable public expense, the poor economy of this neglect is apparent. Stronger words are necessary to condemn this negligence when it applies to plants where disinfection by chlorine is required in order to protect public water supplies, bathing beaches or shellfish grounds.

The New York State Department of Health undertook a survey of sewage chlorinating plants in the state during 1925. As a result of the conditions observed, relatively extensive experiments were carried on during 1925 and 1926, with a view to determining the efficiency and economy of the chlorination process as applied to sewage effluents. The first work undertaken in this connection indicated that there were considerable variations hourly, daily and monthly in the dosage of chlorine required to produce good disinfection, and showed the need of some simple method of controlling chlorine dosage. This led to an investigation of the possibilities of using the orthotolidin test for residual chlorine as generally used in controlling water chlorination.

Present Methods of Chlorine Control—The ordinary practice of state authorities in regulating sewage chlorination before this time has been to fix minimum rates in parts per million at which chlorine must be applied to sewage effluents at all times. In New York State these rates are: "Not less than 24 p.p.m. for raw sewage, 18 p.p.m. for settling tank effluent, 12 p.p.m. for contact or sprinkling filter effluent, and 6 p.p.m. for sand filter effluent" ("Rules and Regulations for the Preparation and Submission of Plans for Systems of Sewerage and Sewage Waste Disposal (1926)," State of New York, Office of State Engineer, Bureau of Sanitary Engineering, Albany, N. Y.). Prior to 1926 only 15 p.p.m. were required for settling tank effluent. In plants where conditions are conducive to the liquefaction of organic matter and production of hydrogen sulphide resulting from septic action, it is possible that these rates may be too low during the hot weather and probably higher than necessary at other times. At one plant (Port Washington) where the application of 15 p.p.m. of chlorine was required, it was found that as high as 26 p.p.m. (215 lb. p.m.g.) were necessary to secure good bacterial removal late in August, 1925. This is not the rule, however, and in many cases operation on this basis results in good bacterial removal, but in a decided waste of chlorine also. Although the cost of chlorine in this locality is only 7½c. per lb. when purchased in quantities used at the smaller sewage treatment plants, the amount required in sewage treatment is such as to make the cost of chlorine a decided factor. In carload lots (15 tons) chlorine costs but 4½c. per lb. in one-ton containers, or 6c. per lb. in 150-lb. cylinders. The prices are net to consumer, including freight on containers in both directions.) Considerable benefits in improved efficiency and economy are, therefore, to be derived by the close regulation of chlorine dosage.

Applicability of Orthotolidin Test—It has been found that the application of the orthotolidin test to the control of sewage chlorination is practicable. Control of chlorine dosage of sewage tank effluents by orthotolidin as compared with starch-iodide tests for free chlorine has been previously reported upon at length (W. V. D. Tiedeman, *Jour.* N.E.W.W.A., April, 1926, p. 391) and only the procedure and conclusions touching on this discussion will be given here. Careful bacterial tests extending over a period of fifteen months on a chlorinated tank effluent from domestic sewage show excellent results when a trace or more of free chlorine is indicated by the orthotolidin test. With residuals of from 0.2 to 0.5 p.p.m. as indicated by the orthotolidin test following a 10-min. contact period between chlorine and sewage, reductions of 99 per cent or more of bacteria, as evidenced by the 37 deg. agar count, and of B, coli, as confirmed by the completed test ("Standard Methods") were effected. Even with only a trace of residual chlorine by the orthotolidin test, results comparable with these were obtained.

Operation on Residual Chlorine Basis—To determine the bacterial efficiency of chlorination of a sewage tank effluent under varying seasonal conditions, the sewage treatment plant at Huntingon, Long Island, was operated during the year 1926 on a residual chlorine basis using the orthotolidin test. Chemical and bacterial analyses were made at frequent and regular intervals throughout the year, by the Division of Laboratories and Research of the New York State Department of Health. The Huntington plant consists of what were formerly shallow Imhoff tanks which have been converted into settling tanks by introducing sewage through the gas vent at one end and taking it out at the effluent weir of the flowing-through compartment at the other and passing it thus through three tanks in series. The tanks are cleaned twice a year. This method of operation gives an effluent high in suspended solids and organic matter, making the test for bacterial removal all the more severe. The plant treats about 0.33 m.g.d. of non-septic domestic sewage with practically no trade wastes. The sewage is rather concentrated as evidenced by the results of the chemical analysis of tank effluent (Table I).

Collection of Samples—A single set of samples was collected each month, taken in each case in the morning at about the time of the maximum hourly concentration of sewage. Chlorine was applied by a solution feed chlorinator with no special device for mixing the chlorine solution and sewage. The reaction channel in this plant is 2.75 ft. wide, about 3.71 ft. deep at average flow and 29.75 ft. long and represents a detention of about 9 min. with average flow. The shortest period

of reaction in each series of samples represents reaction in this channel, the sample being taken at a calculated distance along its length. The sample was then held in a pail at out-door temperature for the longer periods of reaction. The reaction of the residual or excess chlorine was terminated in each case at a definite time by removing this excess chlorine with sodium thiosulphate. About 0.2 c.c. of N/10 sodium thiosulphate was added in each case per 100 c.c. bacterial sample, which is decidedly in excess of that required to neutralize all free chlorine. Bacterial tests have shown that this or even greater quantities of sodium thiosulphate apparently have no inhibitive effects on bacteria as evidenced by the 20 deg. and 37 deg. counts and B. coli determinations.

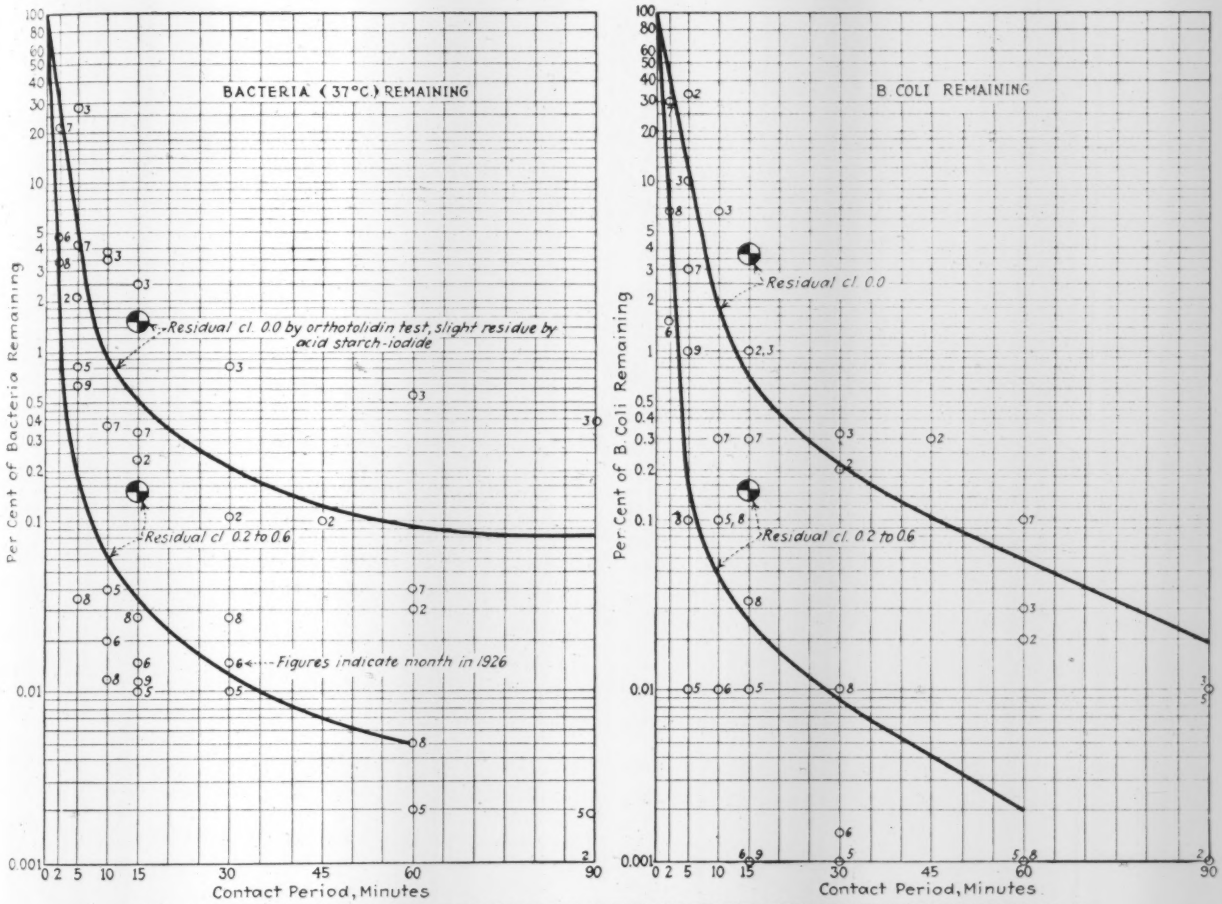

BACTERIA (37°C.) REMAINING
Per Cent of Bacteria Remaining
Residual cl. 0.0 by orthotolidin test, slight residue by acid starch-iodide
Residual cl 0.2 to 0.6
Figures indicate month in 1926
Contact Period, Minutes
B COLI REMAINING
Per Cent of B. Coli Remaining
Residual cl. 0.0
Residual cl. 0.2 to 0.6
Contact Period, Minutes

FIG. 1—EFFICIENCY OF CHLORINATION OF SETTLING TANK EFFLUENT, HUNTINGTON, N. Y.
The tanks, which treat domestic sewage, were built as shallow Imhoff tanks but have been converted to plain settling tanks.

Examination of Suspended Solids—In connection with these bacterial tests on the effluent, additional tests were made in the endeavor to determine whether the chlorine was penetrating the solid particles in the sewage or not. It was found that approximately a 20 per cent increase in total bacterial count over that obtained by the usual method could be obtained on the untreated tank effluent by settling out the solids in an Imhoff cone, macerating these solids in a sterile mortar and adding the count thus obtained to the number of bacteria in the supernatant liquor in the cone. The difference is probably due to the fact that many bacteria either cling to the outside of or are engulfed in the solid particles and, in plating, each particle is counted as one colony instead of each separate bacterium. It is not claimed that the above method will give a true count of the bacteria in the solid particles. Some bacteria may be killed in the process of maceration and some particles may not be completely broken up. The method does, however, show consistently higher results when the solids are macerated and it is believed that the figures for chlorinated and unchlorinated samples by the same method are at least comparable. A somewhat similar method was used by H. P. Eddy in some experimental work at Cleveland. It would require too much space to describe the technique in detail. Using this method, comparative samples of solids from unchlorinated and chlorinated tank effluents were taken each month and the results for 15-min. contact periods are given along with the bacterial results on tank effluents for the same period in Table II. To chlorinated samples sodium thiosulphate was added followed by agitation for the purpose of insuring the termination of the reaction period at a definite time.

Comparative Bacterial Removal—Comparative results for varying contact periods with and without a decided residual of free chlorine are presented in Fig. 1. Each curve represents an average of the results of several series of samples. The individual points are shown numbered according to the month in which the series was run. These curves show a removal of 37 deg.

TABLE I—SUMMARY OF CHEMICAL ANALYSES OF UNCHLORINATED TANK EFFLUENTS AT HUNTINGTON, N. Y.

1926	Nitrogen As Free Ammonia	Nitrogen As Total Organic	Oxygen Consumed	5-Day Bio-chemical Oxygen Demand	Chlorides	Solids Total	Solids Loss on Ignition	Solids Suspended	Settleable Solids in 1 Hr. C. C. per L.
January 7	30	....	110	....	107	638	278	....	....
February 10	20	20	90	....	166	729	264	158	2.5
March 16	30	32	132	....	75	778	381	211	3.0
April 12	40	30	140	....	64	757	385	300	5.5
May 5	40	22	97	....	81	535	233	115	1.8
June 25	30	28.1	92	668*	74	687	344	128	1.0
July 6	30	27	96	532	106	767	381	188	1.8
August 25	30	20.8	112	1,260	164	910	357	168	2.2
September 23	40	16	84	1,272	85	509	219	88	0.3
October 6	45	16.6	100	276	79	540	238	122	0.5
November 9	32.5	35.4	90	408	95	657	293	187	2.0
December 7	35	20.3	114	528	52	550	265	135	1.7

All results except settleable solids in parts per million. Samples collected one day each month at time of maximum hourly concentration of sewage and at same time bacterial samples were collected.
*Oxygen depleted after incubation.

organisms and B. coli, after 10 min. reaction, amounting to 99.9 per cent in all cases where the residual chlorine by the orthotolidin test was between 0.2 and 0.6 p.p.m. With the same residual, the corresponding removal of bacteria and B. coli from the settleable solids in 15 min. is more than 99.8 per cent. In cases where the residual chlorine was zero by the orthotolidin test, but where a slight residual was indicated by the acidified starch-iodide test, a removal of from 98 to 99 per cent is shown in 10 min., although in an hour's reaction a 99.9 per cent removal is effected in both total bacteria and B. coli. In the solids separated from those samples containing no residual as indicated by orthotolidin, the corresponding removals are from 96.75 to 98.5 per cent in 15 min. The effectiveness with which the settleable solids are penetrated by the chlorine is indicated on Fig. 1 by use of targets. The position of each target represents an average computed from monthly results. Arrows indicate from which effluents the solids examined were obtained. The upper targets indicate bacteria remaining in solids separated from effluents containing no residual chlorine, by the orthotolidin test. The lower targets indicate corresponding results obtained when the residual chlorine maintained was between 0.2 and 0.6 p.p.m. In every case the period of contact between solids and chlorine was 15 minutes.

While the results without residual chlorine appear to be rather favorable, it must be remembered that the amount of chlorine applied was bordering upon that required to produce a residual by the orthotolidin test. The tests indicate, however, that a residual by orthotolidin is necessary to insure good bacterial removal. It should be noted that the bacterial content of many of the chlorinated effluents after 15 min. reaction showing residual chlorine by orthotolidin, is as low as could be expected in a good surface water.

Reaction Period—Although greater bacterial reduction results from long detention periods, the increased increment in the reduction is not necessary in most cases and not sufficient to justify the increased cost of building larger reaction chambers. The results would indicate that a 5-min. reaction is sufficient where a residual of from 0.2 to 0.6 p.p.m. by orthotolidin is maintained. Due to minor fluctuations in rates of flow and in concentration, however, it is considered safer to provide a reaction chamber of sufficient capacity to provide 15 min. detention based on average daily flow.

Reduction in Oxygen Demand—The bio-chemical oxygen demand of the chlorinated tank effluent is about one-third less than that of the unchlorinated effluent. Other experimenters have reported similar reductions which cannot be accounted for by any simple oxidizing effect of the chlorine. If this is found to be generally true, a much wider application of tank treatment with chlorination will be possible. In carrying on the bio-chemical oxygen demand test on chlorinated effluents the samples were diluted and then seeded with sewage bacteria.

Practical Advantages of Control—The use of the orthotolidin test would eliminate inconsistencies in the operation of small sewage chlorinating plants which lead to

TABLE II—BACTERIAL EFFECTIVENESS OF CHLORINATION OF SEWAGE TANK EFFLUENT UNDER RESIDUAL CHLORINE CONTROL

1926	Chlorine P.P.M. Dosage	Chlorine P.P.M. Residual By O-t After 15-Min.	Strength of Sewage Total Organic Nitrogen P.P.M.	Strength of Sewage Settleable Solids (1 Hr.) C.C. per L.	Effluent or Solids	37 Deg. Bacterial Count Per C.C. Un-Chlorinated Tank Effluent	37 Deg. Bacterial Count Per C.C. Chlorinated Tank Effluent 15-Min. Contact	37 Deg. Bacterial Count Per C.C. Per Cent Remaining	Number B. *coli* per C.C. Un-Chlorinated Tank Effluent	Number B. *coli* per C.C. Chlorinated Tank Effluent 15-Min. Contact	Number B. *coli* per C.C. Per Cent Remaining
January 7	13.2	0.2	....	....	A	32,000	1,000	0.06	67,000	10	0.015
February 10	....	0.0*	20	2.5	A	440,000	1,000	0.23	330,000	3,300	1.0
March 16	6.0	0.0**	32	3.0	A	110,000	2,700	2.5	100,000	1,000	1.0
March 16	....	....	....	....	B	130,000	1,000	0.77	10,000	670	6.7
April 12	7.7	Trace	30	5.5	A	220,000	325	0.15	100,000	670	0.67
April 12	....	....	....	....	B***	37,000	***240	0.65	[***]1,000	***100	10.0
May 5	9.7	0.2	22	1.8	A	400,000	40	0.01	100,000	10	0.01
May 5	....	....	....	....	B	350,000	170	0.049	100,000	10	0.01—
June 23	11.8	0.6	28	1.0	A	1,600,000	250	0.016	67,000	0	0.0
June 23	....	....	....	....	B	290,000	2,000	0.69	10,000	100	1.0
July 6	11.6	0.0**	27	1.8	A	515,000	1,700	0.33	330,000	1,000	0.3
July 6	....	....	....	....	B	830,000	13,600	1.64	100,000	3,300	3.3—
August 25	11.6	0.3	21	2.2	A	2,900,000	800	0.027	1,000,000	330	0.033—
August 25	....	....	....	....	B	1,100,000	1,300	0.118	100,000	330	0.33—
September 23	10.4	0.5	16	0.3	A	1,200,000	130	0.011	100,000	0	0.0
September 23	....	....	....	....	B	2,990,000	3,600	0.12	100,000	10	0.01—
October 6	10.7	Trace	17	0.5	A	2,400,000	210	0.009	330,000	10	0.003
October 6	....	....	....	....	B	3,200,000	220,000	6.88	100,000	33,000	33.0—
November 9	9.4	0.6	35	2.0	A	380,000	225	0.059	1,000,000	10	0.001—
November 9	....	....	....	....	B	1,600,000	2,000	0.125	100,000	1,000	1.0—
December 7	6.7	0.2	20	1.7	A	1,000,000	550	0.055	66,700	10	0.015
December 7	....	....	....	....	B	1,170,000	11,000	0.94	100,000	6,670	6.67—

A, Tank effluent.
B, Settleable solids from same effluents after 1 hr. settling in Imhoff cone, supernatant drawn off, solids macerated in sterile mortar and diluted to proper volume with sterile water.
* Residual chlorine by non-acid starch-iodide test 0.2.
**No residual chlorine by non-acid starch-iodide test.
*** By method of maceration with glass rod on mat in sterile Gooch crucible.

either the waste of chlorine on the one hand or inefficient bacterial removal on the other: (1) To the small plant operator the chlorination of sewage is often a matter of maintaining a chlorinator in operation at a predetermined fixed number of pounds of chlorine per day. This gen erally leads to underdosing at times of maximum flow when the strength of sewage is also often a maximum and decided overdosing during lower night rates of flow when sewage is generally less concentrated. Again, if this fixed dosage is based on the average daily rate much different results will be obtained than if it is based on the maximum rate of flow. (2) Where an operator gets into the habit of applying a fixed amount of chlorine per day, the amount is not likely to be increased from year to year as the flow increases. (3) In some small sewage treatment plants there are no means of measuring sewage flow and the rate of applying

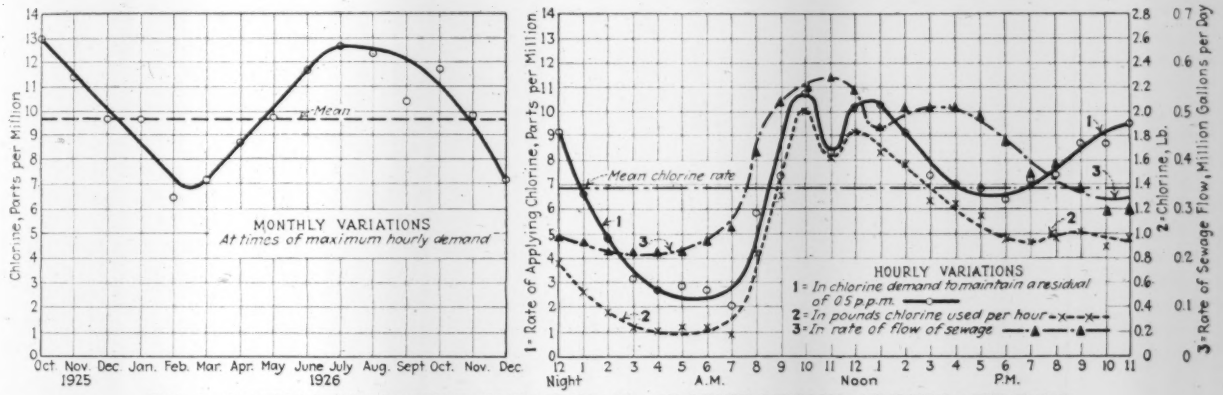

Chlorine, Parts per Million
Mean
MONTHLY VARIATIONS
At times of maximum hourly demand
Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1925
1926
1- Rate of Applying Chlorine, Parts per Million
Mean chlorine rate
HOURLY VARIATIONS
1 = In chlorine demand to maintain a residual of 0.5 p.p.m.
2 = In pounds chlorine used per hour
3 = In rate of flow of sewage
2 - Chlorine, Lb.
3 - Rate of Sewage Flow, Million Gallons per Day
Night
A.M.
Noon
P.M.

FIG. 2—MONTHLY AND HOURLY VARIATIONS IN CHLORINE DEMAND OF TANK EFFLUENT, HUNTINGTON, N. Y.

chlorine is largely a matter of guesswork. (4) The control of chlorine dosage by bacterial analyses is not always satisfactory in that results are not forthcoming quickly enough. On the other hand, a test for residual chlorine is a matter of a few minutes.

Variation in Chlorine Demand—The importance of operating on the residual chlorine basis depends largely on the extent of the fluctuations in chlorine demand, i.e., in the amount of chlorine required to produce a certain residual of free chlorine. During the course of these experiments, it has been found that the variations in chlorine demand of a tank effluent are much greater than was expected. The seasonal demand at Huntington during the last year, based on maximum daily demands, varied from 6.5 to 13 p.p.m. with a yearly average of but 9.6 p.p.m. The hourly demand during a single day has been shown to vary from 2 to 10.6 p.p.m. with an average of but 6.8 p.p.m. in October. These results are presented graphically in Fig. 2. The first chart shows the seasonal variations observed at Huntington while the other shows the hourly variations during a single day. The major factor causing these fluctuations is variation in concentration of organic matter. Temperature is another factor, affecting, as it does, the rate at which organic matter is hydrolized and septic action progresses. Note in Fig. 2, left portion, the increasing demand in warm weather, then the subsequent decrease which reaches a minimum during the colder months of the year, only to resume the upward trend with the advent of spring weather. It is interesting to note how closely this curve showing variations in chlorine demand at Huntington parallels a curve showing seasonal variations in oxygen demand of the Baltimore sewage as reported by Keefer and Regester (*Engineering News-Record*, Nov. 25, 1926, p. 870).

Practical Applications of Chlorine Control—The practical application of the facts just presented to the operation of sewage chlorinating plants deserves considerable attention. The ideal method of operation would be to control chlorine dosage automatically, according to rate of flow and concentration of organic matter. Automatic chlorinators are on the market but means have not yet been devised to vary chlorine automatically to maintain a certain residual. The manual adjustment of chlorine rate from hour to hour to produce a certain residual requires considerable work. It will probably not be practicable in the light of our present experience to attempt to adjust the residual too closely. It is probably best to attempt to secure a residual of 0.5 p.p.m., which will permit considerable fluctuations. Various practical methods of operation to effect savings in quantity of chlorine applied and at the same time insure the best results will be outlined and discussed. In the larger plants the savings in chlorine by hourly adjustments may be sufficient to pay the wages of extra shifts of men to make the adjustments and incidentally improve operation of the plant in general.

Economies Resulting from Control—The estimated costs of operating the chlorinating plant at Huntington, using various methods of chlorine control, are presented in Table III. Following the general practice in New York State in the past, operation would be according to the first method at a cost of $14.44 p.m.g. and results doubtful at times of maximum seasonal chlorine demand. The savings and increased efficiency to be effected by other methods of chlorine control are apparent from a study of this table. These figures are for Huntington conditions, but it is quite likely that similar figures will apply to other sewage chlorinating plants. If automatic chlorinators could be depended upon for continuity of performance, it would appear that for small plants the savings to be effected by automatic operation even at a fixed rate of application, such as 15 p.p.m., would be worthy of consideration. Experience indicates, however, that automatic chlorinators require more careful attention and cost more to maintain than manually controlled equipment. This being true, it appears more desirable and probably less expensive in the case of small plant operation to depend upon dosage control through

use of the orthotolidin test and manually controlled equipment. This holds true even though somewhat more chlorine may be consumed. It is interesting to note that the same economy as in automatic operation at a fixed dosage can be effected with manually controlled apparatus by operating on the basis of regulating the dosage of chlorine daily at a time of peak flow to the amount required to produce a residual of 0.5 p.p.m. Further economies in chlorine consumption would be possible with automatic operation and the dosage determined daily by the orthotolidin test at the period of maximum flow. This plan, however, is subject to the same comments as previously made concerning operation with automatic equipment. Operation on the basis of adjusting chlorine rates by the orthotolidin test at various periods during the day is also possible, although requiring more or less labor. Adjustment to maximum day demand, and to that existing just prior to the operator's leaving the plant for the day, may be possible with a single operator without interfering seriously with other work. In plants treating as much as 5 m.g.d., more than $4,000 per year could be saved in chlorine cost alone by hourly manual control of chlorine dosage on the basis of residual chlorine by the orthotolidin test. This is above the saving to be effected by manual control twice a day. This saving should pay for additional men necessary to effect this method of operation, which in turn, should lead to better operation of the plant in other respects and simultaneously to a higher degree of efficiency in disinfection.

TABLE III—COMPARATIVE COSTS OF OPERATION OF SEWAGE CHLORINATION BY VARIOUS METHODS OF CHLORINATION

Number	Method of Operation	Per Million Gallons Pounds of Chlorine	Cost at 7.5c. per Lb.	Results
1	Fixed rate of chlorine application over entire 24 hr. Dosage applied sufficient to insure not less than 15 p.p.m. computed on basis of maximum rate of flow for the day. (In this case maximum rate was 1.54 times the average daily flow.)	192.5	$14.44	Probably satisfactory but questionable*
2	Fixed chlorine rate. Applying 15 p.p.m. of chlorine (by weight) based on average daily flow. Daily variations in dosage due to varying flow 9.7 to 25.9 p.p.m.	125	$9.38	Unsatisfactory
3	Automatic variation of chlorine application with flow so as to apply 15 p.p.m. of chlorine at all times. *No daily variations in dosage*	125	$9.38	Probably satisfactory but questionable**
4	Fixed chlorine rate for each day based on amount required to produce a residual at the time of maximum chlorine demand and maximum hourly rate of flow. (Mean of maximum daily chlorine demand during year = 9.6 p.p.m.)	123	$9.23	Satisfactory
5	Chlorine rate changed at 8 a.m. and at 4 p.m. based on maximum day chlorine demand and rate of flow and on maximum night demand and rate respectively.	87.8	$6.59	Satisfactory
6	Chlorine rate changed at 8 a.m., 4 p.m. and midnight and based on maximum chlorine demand and rate of flow during each period	79.4	$5.96	Satisfactory
7	Automatic variation of chlorine application with flow at rate adjusted each day to produce a residual of 0.5 ± p.p.m. of chlorine *at time of max. hourly chlorine demand*	96	$7.20	Satisfactory(?)†
8	Chlorine rate varied hourly to maintain a residual of 0.5 ± p.p.m. at all times (3 shifts of men required)	58.4	$4.38	Satisfactory

* Unsatisfactory during times of seasonal peaks in chlorine demand.
** 15 p.p.m. is the minimum rate set by the State Dept. of Health for the application of chlorine at the Huntington plant.
† In small plants dependence upon automatic chlorinators is questionable practice both from the standpoint of overall economy of chlorination and desirability of process.

Technique of Orthotolidin Test—This test, as described in "Standard Methods of Water Analysis" is made applicable to sewage by substituting, at the suggestion of L. H. Enslow of The Chlorine Institute, 1-oz. glass stoppered bottles for Nessler tubes. The standard orthotolidin reagent may be purchased at any chemical supply house. It has been found advisable to use 2 c.c. of this reagent to a 1-oz. bottle of sewage and to compare with color standards after approximately 2-min. contact. Regardless of period of contact the reading should be taken at such time as the color reaches a maximum. With weaker sewages than that at Huntington, 1 c.c. of reagent is generally sufficient. The color standards as proposed by Muer and Hale (*Jour.* N.E.W.W.A., Jan., 1925, p. 50) are used for quantitative readings and in order to allow for the turbidity of the sewage a bottle of sewage is placed in front of the color standard and a bottle of water in front of the bottle containing sewage to which the orthotolidin reagent has been added. The two sets of bottles are placed side by side but with an inch or two between pairs and compared by looking through them horizontally toward the light, in much the same way as in making comparisons for hydrogen-ion determinations. Whether or not this test is an exact quantitative measure of the free chlorine content of sewage, it is a valuable index in plant control. It is also possible to use the starch-iodide test without acidification, but it is not as simple nor as dependable as the orthotolidin test.

Conclusions—The following conclusions may be drawn upon the results of the work at Huntington:

(1) The method of operating sewage chlorinating plants by setting a fixed minimum dosage to be used the year around is inefficient or uneconomical or both.

(2) The orthotolidin test for residual chlorine, while perhaps not giving an exact quantitative measure of the free chlorine in concentrated sewages, is a valuable index and offers a method of control by non-technical operators.

(3) Liquid chlorine, when applied in sufficient quantity to produce a residual of 0.2 p.p.m., as indicated by the orthotolidin test, will effectively disinfect a poorly clarified tank effluent from concentrated domestic sewage.

(4) Contact periods in excess of 5 min. are nonessential where residual chlorine is maintained, except for the purpose of smoothing out minor fluctuations in quantity and quality of the sewage.

(5) The fine solids in tank effluents are penetrated by chlorine when a residual of 0.2 p.p.m. or more is maintained, and efficient disinfection results.

(6) Chlorination of the tank effluent at Huntington results in a noteworthy *permanent* reduction in the biochemical oxygen demand of the effluent.

(7) There are various means of practically applying chlorine control through use of the orthotolidin test to effect varying degrees of economy.

(8) On large plants the saving in chlorine may be sufficient to justify the additional labor necessary to provide hourly control by the orthotolidin test.

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American Ideas at the Economic Conference

Special Report from the International Economic Conference, by E. J. MEHREN, Vice-President, McGraw-Hill Publishing Co.

Geneva, Switzerland, May 21, 1927

A FEATURE of the International Economic Conference was the amount of attention the United States received. We did not, through our own delegates, invite it or force it. Europe took the initiative. She is keenly aware of what we have accomplished industrially and to some extent she understands our mechanism. But the English, the French, the Italians and others say that our methods are not applicable in Europe; the Germans do not say so; they are applying them.

Of course, when speakers make such generalizations they probably take liberties with their own judgments, for, in reality, they are thinking hardest about their particular national conditions. Again they might admit, on being quizzed, that they would apply certain of our methods but not others. But they spread themselves over a large territory when they generalize for Europe.

To their generalizations, the head of the American delegation, Henry M. Robinson, replied that, at least, European countries could adopt our waste elimination program and, abandoning their traditional industrial secrecy, freely interchange information regarding technical methods, research, trade practices, etc. He admitted that, with unemployment large, energetic substitution of machinery for hand labor might not now be possible but he so put the point as to indicate that mechanization was fundamental to Europe's trade and industrial recovery.

Commenting on our much discussed industrial efficiency several delegates denied us perfection by pointing out—and justly, too—our prodigal waste in raw materials (now happily disappearing).

Also, the Europeans believe that in America our tastes are standardized. They contend that mass production in Europe is not possible because the Europeans are individualists and demand articles that have individuality. What a fine chance for debate! Undoubtedly we often sacrifice taste to price and take an article of indifferent appeal because it costs less. But do even the Europeans need variety in pots and pans and stoves and faucets and what not? And have we killed style and eliminated taste entirely? Let each reader make his own answer. The European judgment probably will not be his.

All in all, despite their protests, it is my belief that all the protesting delegations went home more determined than ever that, as rapidly as they can carry out the education of owners, managers and workers, American methods will be applied; also—this thought should not be slurred over—that perhaps the expressed attitude toward American methods is political. For example, with the large unemployment in Great Britain how could the British delegates go home and admit that they had urged mass production and the rapid mechanization of industry?

Thus may politics be shrouding a question of economics, the repercussion of economics on the political order.

America's Foreign Trade—Commenting on the extent of American investments in Europe in recent years, W. T. Layton, editor of *The Economist*, London, asked the American delegation whether America would continue to lend freely but would not buy from Europe. He asked also whether a new equilibrium could be established in which America would buy the natural products of tropical countries on a scale large enough to enable her creditor position to be liquidated by a system of triangular trade.

Replying to Mr. Layton, Mr. Robinson pointed out that our imports of manufactured goods, which come mostly from Europe, have doubled from 1913 to 1926. Europe's own figures of her exports to the United States in 1925 from the five principal countries, Great Britain, Germany, France, Italy and Belgium, show an increase of 76 per cent while her exports to the rest of the world increased 24 per cent. In addition American tourists spent $650,000,000 in Europe last year.

As to triangular trade Mr. Robinson pointed out that ten countries outside of Europe, where European capital is largely invested and where there is virtually no American capital, sold to the United States in 1925 goods to the increased value of 362 per cent as against 1913, while other countries had increased their purchases by only 87 per cent. The United States buys from Brazil three times as much in value as Brazil buys from the United States, but Brazil buys three and three quarters times as much from a "single European country" as that country buys from Brazil.

Pretty good answers they seem to be.

Another point that interests Americans—and surprises them—is the apparent deprecation by Europeans of the possibilities of the home market. Constantly, they harp on America's huge "homogeneous" home market. True, we have a population of 120,000,000 (though not so highly homogeneous as the Europeans imagine). But Great Britain has about 43,000,000, France, 40,000,000 and Germany 60,000,000, surely markets not to be sneezed at. Moreover, one needs to remember that the American market is pretty well supplied; our standards of living are very high compared with those of Europe. Think, then, of the market afforded by the opportunity to raise European standards to a point somewhat nearer the American.

Let it not be thought that the Europeans forget the home market. They do not, but their hourly emphasis on our home market shows that they are inclined to deprecate their own, or at least fail to think of it in terms of large populations capable of being raised to much higher levels. A few did paint the home market in emphatic terms, among them Dr. A. R. Zimmerman, who did such a notable job in Austria.

Economy in Distribution—Also outstanding is a matter of omission rather than of commission—namely, the relative neglect of the need for securing economy in distribution. Several speakers made passing reference to it, but the only vigorous declaration came from Frau Emmi Freundlich, of the Austrian delegation. Of course, the Conference's Committee on Agriculture appreciates the economics of distribution and is giving it a lot of attention.

In America, needless to say, the interest in increasing

efficiency in the distribution of the products of industry promises soon to equal our interest in production economies. Since production methods have been so highly developed we see, too, a larger possible percentage of savings in distribution. This idea surely has not "caught on" in Europe.

In these ways, then, were American ideas before the conference or—by contrast—failed to appear. The further progress of Europe along our paths, or her departure therefrom, will be a study charged not only with interest but with concern for our manufacturers; for, to an extent, Europe is a competitor, a competitor we welcome but about whose progress we must be informed.

* * *

International Economic Conference Recommends Remedies

Geneva, Switzerland,
May 24, 1927

Closing its session on May 23 after three weeks of continuous work, the International Economic Conference at Geneva adopted a long series of recommendations on commercial and agricultural topics and three on industrial subjects.

On the whole, the conferees were quite well pleased with the results. The task was a large one, the problems complicated and the views quite divergent on many points. A goodly degree of accord has been reached. Compromise has been necessary on many items but the result, on the whole, furnishes a good basis for further international economic co-operation.

How speedily the recommendations can be translated into action, where definite action is proposed, can not be foretold. Immediate results must not be expected. The issues would require much time even if only national action were required, but there are various agencies for forwarding the work, such as the economic section of the League of Nations, the International Chamber of Commerce, the International Institute of Agriculture, the International Management Institute. Further, meetings of responsible ministers of the various countries will certainly be convened to consider agreements on various points covered in the recommendations.

Aside from any definite early action there are certain general advantages that should not be discounted. There is now a clear view of the economic ills of the world, and agreement upon remedies, so far as variant national interests would permit. Then there is the great advantage that ministries can quote the Geneva conclusions in support of sound economic policy and legislation and in opposition to the unsound.

This very advantage was one of the great benefits of the Brussels financial conference. The conclusions of that meeting seemed to us in America obvious and simple. Yet, representing the ablest financial counsel in Europe, finance ministries were able to quote the conclusions as authority in getting sound fiscal legislation and policy. If, therefore, in America we think many of the Geneva conclusions extremely simple we must bear in mind that the principles are being violated and that authoritative statement will be of great value.

Not all of the economic ills of the world were surveyed at Geneva. The pressing question of the disposal of surplus populations was not touched, due to the fact that it is too political. Practically no attention was paid to the economics of distribution, to the problem of decreasing the spread between manufacturing cost and ultimate selling price. To this problem we are devoting much time in the United States. But, as it was, the agenda crowded out many topics set down for attention.

Conference Summary of Situation—In addition to the summaries already given [in previous cables and articles Mr. Mehren has given his own summaries of the situation as the points were developed by the speakers] it is worth while to give the Conference's own summary of the economic situation, as set forth in the preambles of the report of the Committee on Industry:

> The chief difficulties now experienced result from the facts that in certain countries sufficient capital has not been available or that, with existing restrictions and under present conditions, the available markets are inadequate for the productive capacity in a number of the principal industries. This maladjustment results from many causes and takes various forms. There is a maldistribution of plant and equipment. In those countries which participated actively in the war, plant in many industries was increased for military purposes beyond the scale of what is required in peace; in other countries, new plant was installed to produce goods which could not be imported during the war; and the experience of war deprivations has developed a desire on the part of a number of nations to make themselves self-sufficing. Moreover, the general impoverishment of Europe immediately after the war lessened savings and handicapped industry by reducing at once the purchasing power of its clientele and the possibility of financial assistance from European money markets.
>
> Other causes have tended to a new distribution of manufacturing equipment; certain discoveries, for instance, have brought about a change in the use of raw materials or in the utilization of sources of energy and a displacement of industrial centers. The normal development of certain repair and finishing industries in partially industrialized non-European countries, and the effort in Europe itself on the part of certain nations with rapidly growing populations to increase their industrial equipment with a view to providing work for an ever-increasing number of individuals, have operated in a like direction.
>
> The war indirectly increased the influence of these causes of instability. It increased the desire of various nations to work up in their own territories the raw materials they produced; it augmented the number and the magnitude of the obstacles placed in the way of the movement of goods by tariffs and prohibitions and of the movement of persons by immigration laws, by passport regulations and by restrictions on the right of establishment in the case of foreigners. Finally, the changes made in the structure of the economic organism as a result of alterations in frontiers, the laborious readjustment of international relations, and the insecurity of the financial and monetary situation have further retarded or impeded the efforts by which the European nations have endeavored to restore order in their industrial economic life.
>
> Of these causes, some are no longer operative, though their efforts may last after them. The danger of great immediate additions to equipment in industries where plant is already excessive is slight in the principal industrial countries; the will to save is being revived and the supply of capital grows steadily; exchange fluctuations are now confined to a few currencies and within much narrower limits than heretofore.
>
> It is on a third category of factors that the Conference has had to concentrate its attention, namely, those which by their nature can in existing circumstances be appropriately modified. Of these the most important are the restrictions and control of the movement of goods and persons and, above all, those which result from tariff and commercial policy.
>
> Finally, owing to the growing facilities for transport and the constantly increasing number of raw materials required for industrial production, the natural development of industry is towards greater international intercourse and larger international enterprises.

Pools or Cartels—Pools or cartels, as already indicated in cables and articles, formed one of the dominant

subjects of the conference and resulted in quite a divergence of views. The conclusion was that they must be considered as good or bad according to the spirit of their constitution and operation and the attitude of their managers toward the general interest. The field for such agreements, both national and international, is usually limited, so the conference declared, to branches of production already centralized and to products supplied in bulk or recognized grades.

Where applicable they can secure a more methodical organization of production, a reduction in cost by better utilization of equipment, the development on more suitable lines of new plant, and a more rational grouping of undertakings, and they can check economic competition and reduce the evils resulting from fluctuations in industrial activity. By this means they may assure to the workers greater stability of employment, and at the same time by the reduction of costs and selling prices bring advantages to the consumer.

Nevertheless, the resolutions declared, if such agreements encourage monopoly and the use of unsound business methods, they may check technical progress and endanger the legitimate interests of sections of society and particular countries. Consequently such combinations should not lead to artificial rise in prices, which would injure consumers, and should give due consideration to the interests of the workers. They should not restrict the supply of raw materials or basic products to any particular country nor create unequal conditions between the finishing industries of the consuming and producing countries. Nor must they prevent the development in any country of industries which that nation considers indispensable.

On the question of control of pools the conference believes that international control of international pools can not be set up. It recommends, however, that the League of Nations study these international pools, their effects on technical progress, on production, conditions of labor, supply and prices. This information, collected with the aid of the various governments, should be published. Such publicity is an effective means, on the one hand, of securing the support of public opinion for agreements which conduce to the general interest, and, on the other hand, of preventing the growth of abuses.

Rationalization—In this series of articles the term rationalization has been taken to mean all mechanisms for reducing cost of production, and therefore the consolidation of industries has been included; this broad definition is in accordance with the German acceptance of the term. However, the conference limited it to scientific organization of labor, standardization both of material and of products, simplification of processes, and improvements in the system of transport and marketing.

While obvious to us in America, the conclusions are so important for Europe that they are given here in full:

The conference considers that one of the principal means of increasing output, improving conditions of labor and reducing costs of production is to be found in the rational organization of production and distribution.

The conference considers that such rationalization aims simultaneously:

1. At securing the maximum efficiency of labor with the minimum of effort;
2. At facilitating, by a reduction in the variety of patterns (where such variety offers no obvious advantage), the design, manufacture, use and replacement of standardized parts;
3. At avoiding waste of raw materials and power;
4. At simplifying the distribution of goods;
5. At avoiding in distribution unnecessary transport, burdensome financial charges and the useless interposition of middlemen.

Its judicious and constant application is calculated to secure:

1. To the community greater stability and a higher standard in the conditions of life;
2. To the consumer lower prices and goods more carefully adapted to general requirements;
3. To the various classes of producers higher and steadier remuneration equitably distributed among them.

It must be applied with the care which is necessary in order, while at the same time continuing the process of rationalization, not to injure the legitimate interests of the workers; and suitable measures should be provided for cases where during the first stage of its realization it may result in loss of employment or more arduous work. It requires, further, so far as regards the organization of labor in the strict sense of the term, the co-operation of employees and the assistance of trade and industrial organizations and of scientific and technical experts.

The conference accordingly recommends that governments, trade and industrial organizations or public opinion as the case may be:

1. Should lead producers to direct their endeavors along the lines indicated above, and, in particular:
   a. To encourage and promote in every way the investigation and comparison of the most adequate methods and most practical processes of rationalization and of scientific management, and of the economic and social results obtained thereby;
   b. To apply these endeavors in industry, agriculture, trade and finance, not merely to large but also to medium and small undertakings, and even to individual workers and handicraftsmen, bearing in mind the favorable effects which they may have in household organization and amenities;
   c. To give special attention to measures of a kind calculated to ensure to the individual the best, the healthiest and the most worthy employment, such as vocational selection, guidance and training, the due allotment of time between work and leisure, methods of remuneration giving the worker a fair share in the increase of output, and generally conditions of work and life favorable to the development and preservation of his personality;
2. Should carry on systematically on an international as well as a national basis the standardization of materials, parts and products of all types which are of international importance, in order to remove the obstacles to production and trade which might arise from a purely national policy of standardization;
3. Should undertake on an international basis investigations for ascertaining the best methods employed and the most conclusive results obtained in every country in the application of the principles set out above, utilizing the investigations already made in certain countries and encouraging the exchange of information among those concerned;
4. Should spread in all quarters a clear realization of the advantages and the obligations involved in rationalization and scientific management as well as of the possibility of their gradual achievement.

Other Resolutions—With reference to the remaining resolutions, sufficient information has been given in articles already published to make repetition unnecessary. The recommendation for adequate international statistics in industry and agriculture will probably be well received in the United States where national statistics, on industry at least, are now effectively used.

Conclusion—All of the recommendations covered in the committee reports and resolutions were referred at the closing session to the League of Nations for such action as the various items required. At the same time the various international organizations previously referred to will take these matters in hand and co-operate with the various League agencies to secure results.

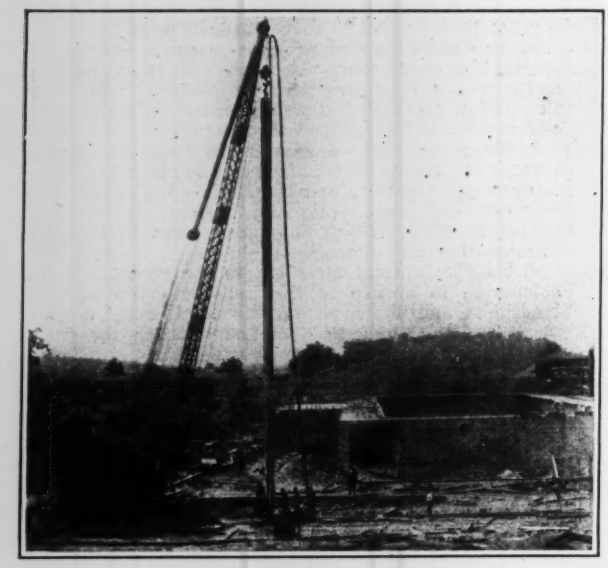
From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Driving 75-Ft., 10-Ton Concrete Piles for St. Louis Water-works Footings

By John C. Allman
Frazier-Davis Construction Co., St. Louis, Mo.

THE boiler house and smokestack footings for the new Missouri River water-works of the city of St. Louis rest on 450 concrete piles, each 75 ft. long by 16½ in. square, and of 10 tons weight. The footings for the boiler house are 3 ft. thick, poured in trenches from 5 to 8 ft. wide and 8 to 10 ft. deep, lined with steel sheetpiling. The tops of the concrete piles project into the footings 1 ft. The piles are mostly in two rows to each trench, staggered, with a few clusters of



PILE 75 FT. LONG BEING LOWERED IN JETTED HOLE

four under columns. Under the smokestack footing, shaped like a flat ring, are 76 piles in three rows.

By taking advantage of the narrow trenches these piles were driven without leads, either fixed or swinging, a 40-ton locomotive crane with an 85-ft. boom handling piles, hammer, and jet without assistance. The apparatus that made this possible was a frame of 6x6x⅜-in. angles bolted to a 13,000-lb. steam hammer with the angles converging below the hammer into a square socket just fitting over the piles.

In driving, a 4-in. jet 10 ft. longer than the piles, fed with water at 160-lb. pressure made a hole to bedrock; then the pile was picked up by the crane, using a shackle and pin, a hole having been originally cast in the top of the pile for this purpose. Hanging plumb and free, the pile was lowered into the hole made by the jet, the latter now being used alongside the pile to help it down until it reached refusal, which was usually within 12 or 15 ft. of rock. Then the hammer, which had been resting on the last pile driven, was picked up, set on the new pile, and, with the aid of the jet, used to drive the pile to rock. If the pile got out of line, which seldom happened because of the deep penetration in the jet hole, it was a simple matter to brace it against the sheet piles. Since the hammer was an underwater hammer, the depth of the jet water had no effect on it, and it could be left setting on a pile as long as necessary. All of the 450 piles were driven to rock or its equivalent, and the top of only one broomed so that the hammer could not be lifted off.

There were a number of advantages to this rig. By having the crane track down the center of the boiler house, which was long and narrow, a number of piles could be driven with one setting of the crane. The jet could be placed at any point around the pile. The time of picking up and setting a pile was very short, and the crew required was small. Also, there was a big saving in excavation in the cofferdams, because with the powerful jet and underwater hammer the soil was washed away from the site of each pile as it was driven, and no previous excavation was necessary. Of course it was necessary to excavate after driving, but that was necessary anyway, due to the silt brought up by the jet.

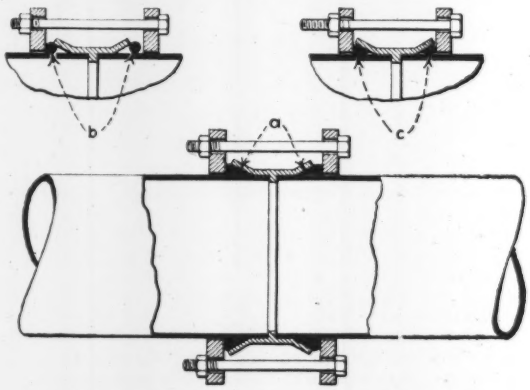
This work was done by the Frazier-Davis construction Co. of St. Louis, and this method of driving was devised by Charles Gove, the superintendent, assisted by H. F. Lawson and W. C. Bratton as foremen.

Emergency Gaskets Made of Baby-Buggy Wheel Tires

H. M. Naylor
Field Engineer, Kansas Public Service Co., Topeka, Kan.

SPECIAL wedge-shaped rubber ring gaskets for the joints of a 20-in. spiral riveted-steel pipe line to be installed for low pressure water service were accidently omitted with the pipe shipment. As the time required for shipment was two weeks or more, and as there was extreme need for the pipe line, it was decided to use a substitute. For this purpose was purchased a quantity of the rubber stock (without wire core) used for re-tiring baby buggy wheels. This can be had in long reels and is usually carried in stock by any good bicycle shop.

For installing, cut off a sufficient quantity of tire



HOW EMERGENCY GASKETS WERE MADE

from the reel, cut a "scarf" joint on the ends, and place in joint. The tire, which can be bought in several sizes, should be of sufficient size that when the clamping rings are drawn up it is deformed until it completely fills in the wedge-shaped space between the gasket ring and the pipe, as shown at *b* and *c* in the accompanying sketch. The gaskets properly supplied for these joints are shown at *a*.

This pipe line, which is partly exposed, successfully passed the initial tests for watertightness, and after six months of service is in perfect condition.

Jacking Culvert Casing Under Railroad Tracks

By O. F. Flumerfelt
Iroquois Gas Corporation, Buffalo, N. Y.

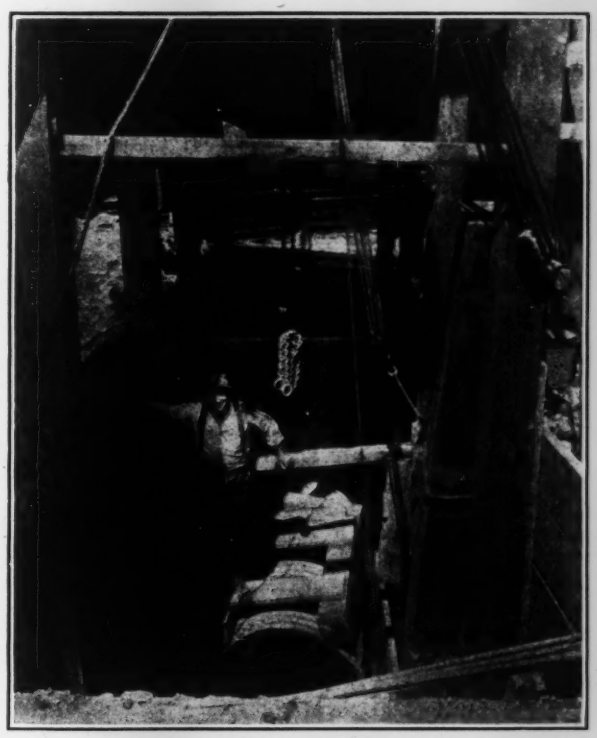
Effecting a 40 per cent saving in cost, the Iroquois Gas Corporation, Buffalo, laid a 20-in. gas main underneath 23 railroad tracks by pushing 352 ft. of 42-in. corrugated metal culvert into position and then laying the main inside of the culvert.

According to a requirement by the railroads, gas mains laid underneath their tracks must be incased in a larger pipe having 5-ft. cover from the base of the rail. The outer pipe is to lessen the liability of leaks from vibration. Heretofore gas mains have been laid in open trenches, excavated and timbered by the railroad company employees, who also shore up the track. The gas company then lowered the casing into the trench, and installed and tested the gas main. The railroad then backfilled and tamped the trench and removed the timbering. The work done by the railroad company was paid for by the gas company on a cost-plus basis, but the open-cut method was expensive.

During 1926 it became necessary to lay mains under several railroad crossings and it was decided, instead of using a 24-in. cast-iron or steel pipe casing as formerly, to use a 42-in. corrugated culvert casing, installed by jacking it into place underneath the tracks.

One of these crossings consisted of 23 tracks belonging to three different railroads, requiring a total length of casing of 352 ft. Three openings were made from the surface, one at each end and the third opening at about the center. These openings were shored with timber to prevent caving. Two stringers laid in the bottom and rigidly tied and bedded served to support and guide the casing as it moved forward. One workman inside the casing excavated ahead, making the hole a few inches larger in diameter than the casings. The dirt was removed in a wheelbarrow or a small box on wheels through the open end of the casing and then lifted to the surface. At intervals of 2 to 4 ft. the casing was pushed forward with two 50-ton ratchet-geared, hand-operated jacks. When the casing had been pushed 30 ft., a short section of industrial track was found to be an advantage in moving the dirt box. The casing was ordered in sections ready-punched for field riveting and as each section moved forward, the next section was riveted in place. A small hoisting drum lifted the dirt box and a portable air compressor furnished power for the air spades and the riveting hammer.

Sections of the casing were pushed in both directions from the center opening and in one direction from the end openings. About 8 to 12 ft. per day, or roughly one foot per hour, could be pushed into place. The entire job was completed in 5 weeks, working one shift per day. The line was staked by transit and by careful alignment of the bed pieces, sections pushed from opposite sides met with but slight discrepancy. Test holes were dug wherever there was any possibility of striking water mains or other underground obstructions. The small space of 2 or 3 in. around the outside of the



JACKING 42-IN. CASING UNDER TRACKS
Showing shoring and casing resting on stringers, with frame used for jacking.

casing, made for clearance in pushing, ultimately fills by settlement and has caused no trouble in track alignment.

In addition to the 40 per cent saving effected in cost, another advantage consisted of working only one shift with no interference or slowdown orders to hinder railroad traffic. The 42-in. casing also permits a man to enter for making inspection or repairs to the gas main. The Iroquois Gas Corporation has adopted this method as standard practice in its operations.

Constant Temperature-Humidity Box for Storing Cement Specimens

The surrounding temperature and humidity during the first 24 hours after making affect the properties of cement and mortar test specimens. For this reason, and to conform to the American Society for Testing Materials' temperature requirements of 70 deg. ± 5 deg. F., a constant temperature and humidity storage box has been developed and put into successful operation at the Bureau of Standards, according to a recent news bulletin of that bureau. Because of the high humidity required, as near to the saturation point as possible to attain, the design of a reliable type of apparatus is difficult.

A large size refrigerator, 40 cu.ft. capacity, was selected for the box proper. Cooling is obtained by a

two-cylinder compressor driven by a ½-hp. motor, with SO_2 as the refrigerating medium. The expansion coils are in the box. Heat is supplied by a nichrome resistance coil in the box. A ½-hp. motor driving a one-stage centrifugal pump circulates the water. The bottom of the box forms a reservoir, the water being pumped and distributed around the top of the box by ¾-in. pipe with small drilled holes. This system is arranged to have the water flow down the sides and two inner partitions. The inside of the box is covered with burlap to distribute and retard the water flow.

The original louvers used as partitions were replaced by six mesh to the inch galvanized-wire screens. These form a very good path for the circulating water. A 1/70-hp. motor drives a blower to circulate the air in the box.

The wet and dry bulb recording thermometers have a slight temperature error because the thermometer proper is of necessity mounted on the outside of the box. A mercury regulator in connection with a control device completes the list of auxiliary apparatus. To eliminate sparking and fouling of the mercury, the device developed by D. J. and J. J. Beaver was modified and applied. Incandescent lamps operating much below their normal voltage are used for resistance, and the relay of the Beaver apparatus is used to operate a second alternating-current relay which throws the heater or refrigerator into operation.

To simplify the control apparatus, the heating and cooling effect were so arranged that either one or the other operates. "It is theoretically more efficient to have a neutral zone with a small range with neither heating or cooling effect," says the bulletin, "but this would require a control apparatus many times more complicated, with the resulting greater liability to breakdown more than counterbalancing the advantages."

Center Joint Made by Ball and Socket Bond

A BALL-SOCKET center joint has been used on a 7-in. reinforced-concrete pavement on Hickory St., Kankakee, Ill., for which a number of advantages are claimed. The ball-socket device is used for longitudinal

FIG. 1—FORMS FOR PLACING BALL AND SOCKET PAVING JOINT

center joints and for tying a combined curb and gutter or curb to pavement slabs. Some 2,100 ft. of this type joint have been installed. The joint is of sufficient strength to tie the slabs securely together, thereby resisting any shear caused by heavy traffic. The ball-socket longitudinal hinge joint is installed by bolting to the wood or metal forms a hemispherical knob over

From Job and Office

Hints That Cut Cost and Time

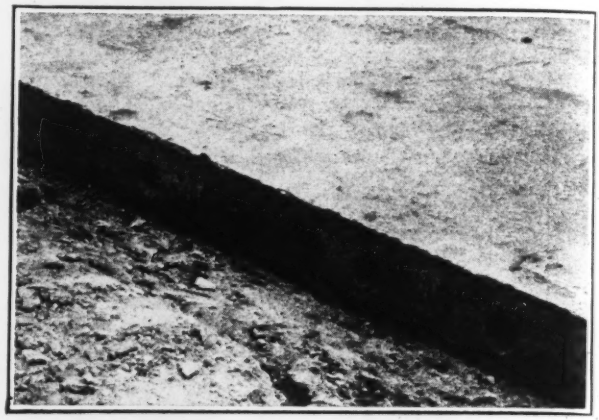


FIG. 2—EDGE OF SLAB TO BE FASTENED TO ADJACENT SLAB BY BALL AND SOCKET JOINT

which is snapped a bell-shaped metal cup. This cup remains in the concrete, and is sprayed with or painted with asphalt or a heavy road oil to insure a perfect hinge. The use of dowels for transverse joints is said to be unnecessary, when the ball-socket is used.

The joint has been developed by Robert D. Gregg, city engineer of Kankakee, Ill.

Laying Water Main Across Small Stream

By D. S. McGlashon
Resident Engineer, Kirksville, Mo.

IN CONSTRUCTING the distribution system for the new water supply at Smithville, Mo., it was necessary to lay two 6-in. cast-iron lines across the Little Platte River. At the points of crossing, the banks slope to the water's edge at the rate of about 3 ft. in 10, and the river bed consists of a 3-ft. layer of rather stiff mud overlying solid rock. It was desired to have the pipes well embedded in the mud.

The pipe selected was standard flexible joint cast-iron, ball-and-socket type, in 12-ft. lengths, with a possible deflection of about 13 deg. per joint.

The work was done during cold weather in January when the river was frozen over; the ice being used as a working platform. Trenches were dug to the required depth and grade down to the water's edge, a strip of ice sawed out and the excavation continued with long-handled "spoons" by men on the ice, the main purpose of the under-water trenching being to determine the non-existence (as it so happened) of logs or boulders in the way, and to loosen up the mud somewhat.

In the bottom of one trench, back away from the water, some 2-in. planks were laid, with bell hole openings, and all pouring and calking were done at the one point, for each line of pipe.

On the opposite side of the river a "dead man" was embedded across the bottom of the trench, with the soffit set to the elevation of the top of the pipe when laid; while back up on the bank was anchored a stump puller, with a ⅞-in. steel hauling cable, provided with a heavy ring which would just pass through the pipe.

A section of pipe was laid on the planks, with the

From Job and Office

For Contractor and Engineer

spigot toward the water, another section placed (care being taken to have the ball nicely "home" in the socket), poured and calked; no yarn being used as this pipe is machined and the lead will not leak through.

The cable was then threaded under the "dead-man," brought across and pulled through the two pipes by means of a heavy wire, and a linch-pin put in the ring. A wooden plug having a longitudinal slot in the top side to permit free movement of the cable was driven into the spigot end of the first pipe and the protruding end sharpened. Then with the stump puller the pipes were pulled ahead 12 ft. so that the last hub came to the bell hole, another pipe joined on, the stump puller reversed, the slack cable pulled back through the third pipe, linch-pin inserted, and pipes again moved forward. This was repeated until the required number of sections had been used, the wooden "nose" plowing its way through the mud in the river bottom, emerging on the opposite side and passing smoothly under the "dead-man," and the flexible joints conforming easily to the approximate catenary.

As the first pipe was necessarily submerged for some time and the slot in the plug had to be a loose fit to permit feeding back the cable, some water leaked into the line, which, however, was easily swabbed out with sacks tied to a rope.

Rapid Field Method of Determining Characteristics of Sand

By Cloyd M. Chapman

Consulting Materials Engineer, Dwight P. Robinson & Co., Inc., New York City

ONE of the factors which has tended to retard the universal adoption of accurate methods of control of the proportioning of concrete materials is the objection on the part of the contractors and superintendents to making any sort of tests on the job. They dislike to be bothered with any of the field tests needed to insure a constant water-cement ratio.

If a definite quantity of water is to be used in each batch of concrete it is necessary to know how much water is introduced into the batch with the sand, whether the sand is measured, weighted or inundated. When measured or weighed the amount of moisture must be determined. When inundated the amount of voids in the sand must be determined for these voids are filled with water.

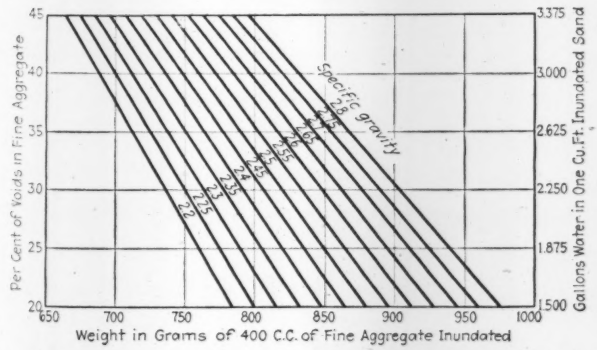
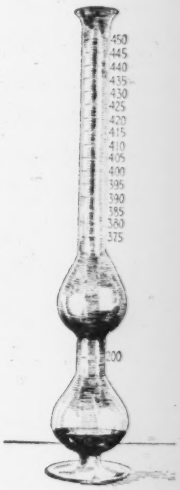


DIAGRAM FOR DETERMINING PER CENT OF VOIDS IN FINE AGGREGATE

To meet some of the objections that have been raised to making field tests of voids or moisture a new type of field test has been devised for rapid determinations of surface moisture or voids or apparent specific gravity of a fine aggregate with simple and inexpensive apparatus.



CHAPMAN FLASK USED FOR FIELD MEASUREMENTS OF SAND

The necessary equipment consists of scales, a special flask, such as is shown in the illustration, and suitable diagrams for interpreting results. The diagram for use in determining per cent of voids in inundated fine aggregate is shown in the chart herewith. The lower bulb of the flask is filled about three-fourths full of water. The sand to be tested is poured into the flask and if necessary more water is added until the level of both the sand and the water are at the 400-c.c. mark on the upper neck of the flask. The flask and contents are then weighed, the weight of the flask is deducted, and by means of the chart the per cent of voids or the number of gallons of water per cubic foot of inundated sand is read directly from the chart.

If the specific gravity of the sand is to be determined, 500 grams of a surface dry sample are weighed out and introduced into the flask in which 200 c.c. of water have previously been placed. The combined volume of the sand and water is read on the upper neck of the flask. By the use of a chart furnished with the flask the approximate apparent specific gravity is determined without mathematical work.

When the moisture of a damp sand is to be determined the procedure is to fill the flask to the 200-cc. mark on the lower neck, introduce 500 grams of the damp sand into the flask and read the combined volume of the sand and water on the upper neck of the flask. By the use of a chart somewhat similar to that shown herewith, either the per cent of moisture in the sand or the gallons of water in 100 lb. of the sand may be read directly.

Job and Office Notes

To Stop, Temporarily, Leaks in Chlorine Cylinders, the Electro Bleaching Gas Co., Niagara Falls, N. Y., suggests pouring water over the nozzle. The chilling action due to the evaporation of the liquid chlorine is so great that the water will freeze around the open valve, thereby reducing the flow of gas. Although the ice will soon melt, the cylinder can in the meantime be safely handled and the leak stopped.

A "Beam Calculator" for Computing the Sizes of Steel Beams knowing the load, span and unit stress, has been designed by Carl H. Sorensen, South Jacksonville, Fla. It consists of a movable circular disk and a celluloid arm mounted on a letter-sized sheet of cardboard. The circular disk contains scales showing sizes of I-beams, channels, girders, angles, and a second scale with loads in thousands of pounds. The square scale contains the fiber stress scale, arranged for fiber stresses from 12,000 lb. to 18,000 lb. The section modulus and moment of inertia of a beam can also be found by making one setting of the scales.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Basic Data for Mississippi River Problem

Sir—In the many discussions of the Mississippi River flood that have appeared in the technical and popular press little has been said in regard to the fundamental fact which must govern the solution of this great national problem—namely, the quantity of flood discharge for which channel capacity must be provided.

Plans for solving the flood problems in the Mississippi Valley and for utilizing this river system and the lands in its basin will be inadequate unless they are based on complete and detailed information in regard to the total flow of the river, the yield of the tributary basins, the seasonal and annual variations in flow, the origin and probable volume and frequency of floods, and the degree of probability that floods of tributary basins will synchronize on reaching the Mississippi. These data are required for the design, operation, and administration of the works needed for flood protection and other purposes.

Although millions of dollars have been expended by the federal government and other agencies for control and utilization of water in the Mississippi River basin, continuous reliable records of stream flow in this basin have not been made available nor has even a start been made toward their systematic collection.

Governmental and private reports, both published and unpublished, contain many flood estimates that have been greatly exceeded by subsequent floods, for in the absence of adequate records of discharge it is impossible to estimate flood flows with accuracy. A striking example is afforded by various estimates of the probable floods of Sacramento River. In 1881 the maximum flood discharge of Sacramento River was estimated at 100,000 sec.-ft. The report of the Commissioners of Public Works of California for 1905 contains what is generally known as the "Dabney report," prepared in 1904 by a board of engineers consisting of T. G. Dabney, state levee engineer, Mississippi; Henry B. Richardson, member of the Mississippi River Commission; M. A. Nurse, chief engineer, State of California, Commissioner of Public Works; and Maj. H. M. Chittenden, Corps of Engineers, U. S. Army. This report outlines a project for the rectification of Sacramento and San Joaquin Rivers and their principal tributaries and the reclamation of the overflow lands adjacent to them. Paragraph 8 of the report (p. 30) states:

> From the foregoing data, and with the allowance for the conditions described in the last paragraph, it is believed that any scheme looking to the carrying of the runoff of the Sacramento watershed within the leveed banks of the river should make provision for a discharge of 250,000 sec.-ft. below the outlet of Cache slough.

The report on the Sacramento flood-control project, revised plans, submitted to the Reclamation Board by W. F. McClure, state engineer of California, in February, 1925, states (p. 12): "The floods of 1907 and 1909 demonstrated the fact that floods more than twice as large as that for which the Dabney project has been designed should be used as a basis for a flood control project," and (p. 18) "during cycles of wet years, general floods as much as 50 per cent greater than the 1907 flood may occur."

A complete history of the flood-control situation on Sacramento River may be found in "Extract from House Report No. 616, Control of Floods on the Mississippi and Sacramento Rivers—Supplemental report on flood control of the Sacramento River," submitted by Mr. Curry, of the Committee on Flood Control (to accompany H. R. 14777), 1916.

The estimates quoted were the best that could be made from the data available, and no criticism can justly be directed at the engineers who made them or the organizations represented. They are presented here only as an illustration of the futility of attempting to use any substitute for actual stream-flow data. Though Sacramento valley had been inhabited for many years and extreme floods had been experienced, it was only in 1902 that collection of systematic records of discharge was begun, and only within the last decade that reasonably reliable estimates of flood flows could be made.

The Mississippi River problem is especially complicated on account of the wide differences in character of the tributary areas that make up the drainage basin. The ultimate design of protective and other works needed for the solution of the problems of control and utilization will depend primarily on the use or uses of the river channel and the lands in the basin, and many schemes are being presented by engineers and others for preventing floods and solving other problems related to the use of the river and its valley. Unless these schemes are properly evaluated and co-ordinated and the major phases of the problem are kept in view, discussion of them will tend to distract attention from the main issue, and the outlook for a plan that will provide adequately for the future will not be hopeful.

The growth of the United States has been so rapid that many enterprises for the use or control of water resources have been developed without adequate information as to the extent of the resources on which they are based. Disasters from deficient or excessive stream flow have resulted. The recent catastrophic failure of control works on the Mississippi River is the latest and most overwhelming disaster attributable to building costly engineering works with insufficient knowledge of the natural forces they were created to restrain. In spite of this grave disaster it is not too late to begin a systematic study of stream-flow characteristics, never heretofore determined for the Mississippi, in order that control of flood water may be planned and developed with full knowledge of all the elements that bear on the problem. The extent of the natural forces to be dealt with can reasonably be foreseen and determined and such disasters can be prevented by timely collection of basic information.

The control and utilization of the Mississippi River involve never-ending problems. Records collected will be useful for all future time and will serve to guide the future utilization of the river as well as the current inception of flood-control and other plans. Their collection should be supervised by engineers who are especially trained in the collection, interpretation, and use of stream-flow data and whose main function is research unbiased by any direct interest in the construction and administration of engineering works. Such engineers should be provided with adequate authority and funds.

The collection of fundamental data has no relation to controversial questions, which of course must be considered from all angles and decided on their merits. There is no excuse for delay in making adequate provision for the work of research that is needed as a basis for any and all sound schemes.

JOHN C. HOYT,
Hydraulic Engineer in Charge,
Division of Surface Waters, Water Resources Branch, U. S. Geological Survey.

Washington, D. C.,
June 1, 1927.

Relation Between Fineness Modulus and Concrete Strength

Sir—Studies, such as that reported in the May 19 number of *Engineering News-Record*, p. 814, by H. O. Olson appear from time to time in the attempt to prove or disprove that there is a relation between the fineness modulus of aggregates and the strength of concretes. The fact that the fineness-modulus method of measuring aggregates is, like the surface-area method, but a rule of thumb scheme, settles this matter.

Suppose that we have the following aggregate:

Amount of material passing each sieve and retained on the next smaller									
Sieve No.	1½	¾	⅜	4	8	14	28	48	100
Sieve ratio	1	½	½	½	½	½	½	1/2.28	1/2.58
Amount, per cent	4	7	7	5	7	11	25	20	14

In the fineness modulus method no weight is given material passing the smallest sieve and for each other sieve the amount is weighted in accordance with an arithmetical progression as follows:

	Fineness modulus									Total
Amount, per cent	14	20	25	11	7	5	7	7	4	100
Factor	0	1	2	3	4	5	6	7	8	
Result	0	.20	.50	.33	.28	.25	.42	.49	.32	2.79

In the surface-area method the total areas of the volumes through the sieves vary inversely as the sieve diameters, maximum weight being given to the material passing the

smallest sieve, and for each other sieve the amount being weighted in accordance with a geometrical progression as follows:

	Surface Area									Total
Amount, per cent..	14	20	25	11	7	5	7	7	4	100
Factor.....	256	128	64	32	16	8	4	2	1	
Result.....	35.84	25.60	16.00	3.52	1.12	0.40	0.28	0.14	0.04	82.94

In comparing these two schemes we see that the fineness modulus method gives no weight to the material passing through the No. 100 sieve while the surface area method attaches maximum weight to this material. When the one is a maximum the other is a minimum. Each is but a rule of thumb method and neither can measure various aggregates in such manner as to guarantee concrete strengths.

Fort Leavenworth, Kan., May 23, 1927.

F. S. BESSON
Major, Corps of Engineers
U. S. Army.

Locating Street Car Tracks Away from Center of Street, St. Paul and New York

Sir—Referring to the letter of F. S. Foote in *Engineering News-Record*, Jan. 27, p. 166, relative to putting street car tracks near the curb, and an answer to Mr. Foote's letter by C. M. Durgin in the issue of March 17, p. 460, I am enclosing herewith a plan worked out for University Ave., St. Paul, which provides the safety features which Mr. Foote is striving for and removes the objections as outlined by Mr. Durgin. The cross-section shows the space assigned for each purpose. The street car would run 10 ft. in the clear from the curb, in this way not interfering with the parking of cars, endangering children or spattering muddy water. At the stopping places the curb and sidewalk are extended out so that passengers can step from the curb to the street car. This leaves the center of the street for moving vehicles that are not in any way disturbed by the street car, stopping for open gates, etc.

This plan has not been put into effect and may not be at once as the idea is new. However, it seems to be the solution for this street. The space between the street car and curb for parking is as ample as is found on any business street with a 40-ft. roadway and a double car line.

There is one other factor to be considered, and this is the use which is going to be made of the bus. In St. Paul all bus lines and taxi cab lines are owned by the street railway company, and just what use is to be made of the bus in the future is not now apparent. If bus lines are to run parallel to street car lines then it would seem that the bus, which is the most pliable machine, could be used to do the picking up at corners and the street cars could be used for express service, stopping only every three or four blocks or half mile. In which case this plan would not be applicable to long stretches of street but could be used for short stretches.

GEORGE H. HERROLD,
Managing Director, City Planning Board of St. Paul.

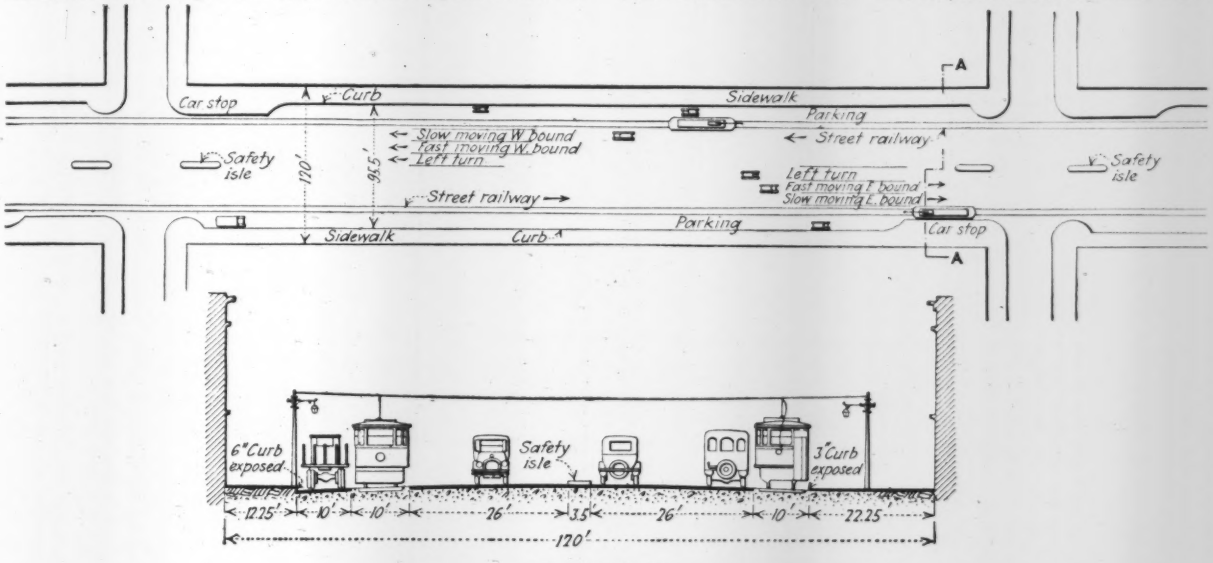
St. Paul, Minn., March 30, 1927.

Sir—Your columns have recently carried some interesting letters on proper location of street railway tracks, beginning with C. M. Durgin's letter in your March 17 issue.

In the writer's opinion there is no one solution for this problem, as the proper location of tracks depends on many things, particularly the width of the street between curbs and the kind and amount of vehicular traffic.

We would like to bring to the attention of your readers a solution which has proved satisfactory for a particular set of circumstances which are becoming duplicated quite frequently in the larger American cities.

The track arrangement referred to is in New York City in the Borough of the Bronx on Fordham Road from Third Ave. to Southern Blvd. This location is on the main auto-



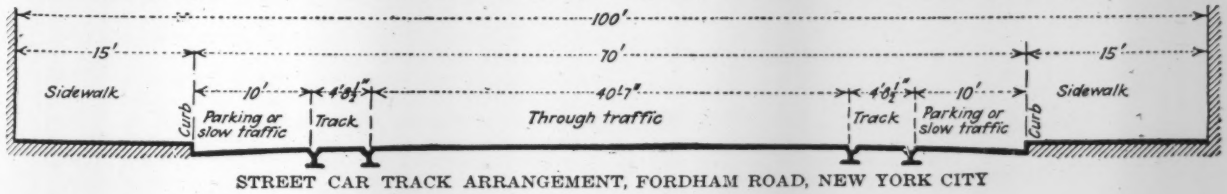
Section A-A

PROPOSED PLAN FOR UNIVERSITY AVE., ST. PAUL

mobile route from New York to southern New England and carries extremely heavy pleasure car traffic. It is also a business street, carrying a double-track street car line.

The width of the street between building lines is 100 ft. and between curb lines 70 ft. Trolley tracks are located neither in the center of the roadway nor on the very outside but are located with the nearest rail 10 ft. from the curb line, leaving an unobstructed central traffic way of 40 ft. 7 in. between rails, as shown on the accompanying drawing.

This design provides two lanes in each direction for fast moving automobile traffic and this traffic is not required to slow down on account of the trolley cars. It also provides two additional lanes of traffic on each side of the street outside of the high speed lanes, thus providing in all eight traffic lanes. One of these lanes next to the curb may



STREET CAR TRACK ARRANGEMENT, FORDHAM ROAD, NEW YORK CITY

be used either for slow moving traffic or parking. The second lane is used jointly by the trolley cars and the slow moving traffic.

By this arrangement passengers can enter and alight from trolley cars without danger of being run down by fast moving traffic and it is unnecessary to provide loading platforms or safety isles, so that the entire roadway is available for traffic.

Trucks can load or unload at the curb and parking can be permitted if desired without interfering either with the fast moving traffic or the trolley cars.

It is to be noted that this desirable arrangement is practicable only with a minimum roadway width of 70 ft.

This roadway arrangement has been in use for two years and is well worth visiting by those who are interested in this particular traffic problem. The result seems to be very satisfactory to all concerned.

E. M. T. RYDER,
Way Engineer, Third Ave. Railway System.

New York, N. Y.,
April 29, 1927.

Water-Cement Ratio and Maximum Strength

Sir—It is perhaps out of fashion for concrete engineers not to believe Professor Abrams' theory of concrete proportioning. In spite of such extensive publicity and its consequent popularity, not only are contractors in the field encountering practical difficulty in handling dry concrete, but it seems to the writer that there is a lack of complete consideration of different factors in interpreting the mass of test results upon which the theory is based.

Usually curves are given with this theory, known as the water-cement ratio theory, to show the effect of the quantity of mixing water on the strength of concrete determined from tests at 28 days. It presupposes that the aggregates are clean and structurally sound and that the concrete is made under average conditions and cured in the presence of moisture. The amount of water per sack of cement used is regarded as the independent variable of the problem and the strength of the resulting concrete at 28 days is held to have been shown to be a function of this factor.

Now, due to the different rate of gaining strength for concrete of different consistencies, the only comparable standard between different mixes, so far as strength is concerned, is its maximum attainable strength. If the strength of each specimen of different water content is not at any time an equal proportion of its maximum attainable strength, the comparison of test results at 28 days is likely to be different from the relative strengths at greater ages. Of course, the maximum attainable strength cannot be very well determined, for concrete increases in strength almost indefinitely with time and short period tests are mainly relied upon. But this element of time inevitably introduces an important variable into our problem. Unless we know beforehand the effect of age upon compressive strength of concrete of different consistencies, the result at 28 days is not indicative of its final strength. It was known among the earliest workers in concrete that a dry mixture generally develops greater strength in a shorter period. Professor Abrams' result then is not surprising. This question becomes all the more important as the rate of variation of strength is undoubtedly more marked during the earlier stages than at any other time.

The writer had the opportunity of attending a series of public lectures on the proper design and control of concrete mixtures given by experts connected with the Portland Cement Association at Boston in 1926. The lectures were of educational nature and expounded upon this water-ratio theory. In order to prove its correctness, test cylinders of different water content were made and broken at 28 days. The different mixtures were designed and controlled with the intention of securing an average strength of 3,000 lb. per sq.in. and a minimum of 2,500 lb. per sq.in. There were three cylinders to each mix and the results were very uniform within each set. They were:

Mix	Aggregate	Water, Gal.	Water-Cement Ratio	Slump	Flow Table	28-Day Strength
Ordinary (field) 1:2:4	Scituate sand and gravel	7.50	1.00	7.50	196	1,350
Scientific 1:1.9:4.2	Same	6.00	0.80	6.25	188	2,025
Scientific (excess water) 1:1.9:4.2	Same	7.00	0.93	7.50	203	1,995
Scientific 1:3.25:3.45	Plum island sand and crushed stone	6.00	0.80	0.50	138	2,250

The 12 per cent excess of water did not appreciably decrease the strength, nor was the expected 3,000 lb. per sq.in. strength ever attained. All this shows the complexity of the problem we are dealing with. And in making scientific tests to determine simple and fundamental properties, the principle that one and only one variable should be investigated at a time should not in any way be violated. Because of so many varying factors, the writer realizes the difficulty in making worthwhile researches in concrete. Unless the test results coincide very nearly with a proposed curve, one has no right to preach theories making it capable of virtues like a mathematical curve. And if the test results are such that they are not on a comparable basis due to the influence of another factor, it is unscientific to present theories under the mask of insufficient analysis as if they are a panacea for all troubles in concrete.

T. KUO,
With American Bridge Co.

Trenton, N. J.,
April 13, 1927.

Detroit and Vicinity Following Master Plan

Sir—I note in your issue of May 19, 1927, p. 801, an editorial on progress in city planning, in which you make the following statement: "The notable exception of adoption of an official plan with means provided to see that the plan is followed—or departed from only after careful deliberation—is afforded by Cincinnati, one of the most notable achievements of the past two decades."

In March, 1923, the engineers of the Rapid Transit Commission of Detroit designed a transportation street for the purpose of combining the requirements of individual and collective transportation in the area surrounding the built-up portion of Detroit, and planned the transportation routes that would serve the city when it has a population of three million and upward, the commission laying out a system of superhighways and intermediate roads and major thoroughfares within the present city to serve the entire area likely to be occupied by the future city.

In April, 1924, this plan was submitted to the Counties of Wayne, Oakland and Macomb, which surround Detroit, and to the numerous independent municipalities included within the 15-mile circle. The plan having been approved by these bodies, it was then submitted to the city of Detroit by the Rapid Transit and the City Plan Commissions, and on April 14, 1925, it was adopted by the Common Council as the Master Plan of the City of Detroit.

At this time the council created an advisory committee to find ways and means to execute the plan, and as a result of the report of this committee, on Nov. 3, 1925, the people voted overwhelmingly in favor of a charter amendment setting aside an annual amount equal to one mill on the entire assessed valuation of the city for the sole purpose of creating a fund to widen the streets named as major thoroughfares on the master plan.

Prior to the adoption of the master plan the Rapid Transit Commission had secured from the legislature in its session of 1925 the necessary legislation to permit the counties embraced in the regional area to join in the acquisition of right-of-way to accomplish the master plan. In December, 1925, the counties combined in the creation of two superhighway commissions—the Macomb-Wayne and the Oakland-Wayne. The legislation authorized these Commissions to tax the entire property of the three counties to the extent of a half-mill. This right has not yet been exercised, but in the period since their creation in December, 1925, these superhighway commissions have acquired 204 miles of frontage right-of-way on superhighways and intermediate roads, about 80 per cent of which has been dedicated, and within the city similar progress has been made on the widening of the major thoroughfares.

On July 16, 1926, the Common Council passed an ordinance directing that all plans of subdivisions offered must, as a condition of acceptance, conform to the position and width of the thoroughfares indicated on the master plan.

There is no doubt that the Cincinnati plan was a notable achievement. However, in your survey of the field of achievement, honorable mention might reasonably be given to the Detroit plan as an instance of complete co-ordination of independent administrative bodies in the economic interest of the entire regional development.

JOHN P. HALLIHAN,
Chief Engineer, Rapid Transit Commission.

Detroit, Mich.,
May 21, 1927

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Floods in Tributaries Cause New Rise in Mississippi River

The possibility of a rise in the Mississippi River in the lower portion of its valley which was noted last week, has developed during the week until it now is evident that the so-called "June rise" will be quite serious. Gages are rising on most of the tributaries, as indicated in the accompanying table, especially to the east of the main river where floods have occurred in eastern Kentucky, Tennessee, Indiana and western Virginia, causing considerable damage and some loss of life. On the western side of the Mississippi valley the Arkansas rose rapidly at Fort Smith, but is falling again. Already the Mississippi is beginning to feel the effects of these rises in the tributaries. At Cairo the river is above flood stage again. The advance of this secondary flood is now between Memphis and Vicksburg.

This rising of the Mississippi and its tributaries will postpone the closing of some of the breaches in the levee system and will delay the unwatering of much area in the flooded region. Reports from the Arkansas River valley indicate that land from which the flood has receded is now under water again.

GAGE HEIGHTS THROUGHOUT THE MISSISSIPPI VALLEY

	Cumberland River Nashville, Tenn.	Tennessee River Florence, Ala.	Ohio River Evansville, Ind.	Missouri River Kansas City, Mo.	Mississippi River Cairo, Ill.	Mississippi Memphis	Arkansas Fort Smith, Ark.	Mississippi Vicksburg	Red River Shreveport	Mississippi New Orleans
Flood Stage	35	18	35	22	45	35	22	45	29	17
1927 High	30.4	15.3	44.5	24.8	56.4	45.9	36.7	58.7	37.4	21.0
May 24	9.3	2.0	24.3	16.4	36.6	31.8	11.9	51.9	16.0	20.0
May 25	9.3	1.8	26.1	15.6	37.0	31.4	10.6	51.8	17.0	19.9
May 26	9.8	2.0	27.7	14.8	38.0	31.0	9.5	51.3	17.8	19.7
May 27	9.8	2.0	29.7	14.5	39.1	30.7	9.7	51.0	18.1	19.5
May 28	10.7	2.1	30.8	14.5	40.2	30.7	9.9	50.6	17.9	19.4
May 29	....	....	....	....	....	....	....	....	....	....
May 30	14.0	1.8	32.9	18.6	42.2	31.5	9.5	50.0	18.6	19.0
May 31	20.2	2.0	33.0	19.0	43.2	32.1	8.4	49.7	17.6	18.8
June 1	23.8	2.6	33.1	18.4	44.2	32.6	8.0	49.3	16.4	18.6
June 2	25.9	3.3	33.4	17.3	45.3	33.2	8.2	49.0	15.3	18.4
June 3	26.7	6.6	33.6	17.4	46.2	33.7	13.7	48.7	14.4	18.3
June 4	26.9	9.8	33.9	18.9	47.0	34.3	17.5	48.4	14.2	18.1
June 5	26.8	....	34.0	18.7	47.8	34.8	17.2	48.2	14.4	18.0
June 6	25.9	....	33.8	19.3	48.5	35.4	16.5	48.1	14.1	17.9
June 7	23.5	....	33.2	18.8	49.2	35.8	16.2	47.9	13.8	17.8

Toll Bridges in California to Be Under Scrutiny

The California Highway Commission, in accordance with a bill passed at the recent session of the legislature, is to investigate toll bridges that are operating as connecting links in the state highway system and to report to the 1929 legislature on some plan whereby such structures might be acquired by the state. The report is to offer a plan for financing the acquisition of such bridges and amortizing "the cost of such acquisition by tolls; such bridge or bridges then to be free of tolls and be made a part of the state highway system."

Will Ask Consultation on Wanaque Aqueduct

Engineer to be Chosen June 16 to Report on Concrete Conduit-Steel Pipe Controversy

At a conference on June 2 between the North Jersey District Water Supply Commission and several of the municipalities which are being served by the Wanaque Aqueduct it was announced that the commission would meet on June 16 with representatives of various municipalities to select a consulting engineer to report on the controversy that has arisen in regard to the design of the aqueduct carrying the Wanaque supply, as reported in these pages several times in the past month.

Col. George A. Johnson, who was called in by the commission to report on the aqueduct, reported that a steel pipe line should be substituted for the concrete aqueduct which has been designed by Arthur H. Pratt, chief engineer for the commission in consultation with Morris R. Sherrerd, the consulting engineer to the commission. Colonel Johnson's report, together with the replies made by Mr. Pratt and Mr. Sherrerd, has never been made public by the commission. It was announced at the June 2 meeting, however, that the commission would furnish the municipalities with copies of these reports. Up to the time this issue went to press, however, the commission has failed to supply this journal with such reports.

Mayor Raymond, one of the four members of the commission, stated at the June 2 meeting that the commission's decision to use twin steel lines for the aqueduct was not final. He further said, according to the report in the Newark *News:*

> "We are not a high and mighty body averse to suggestions on how to meet these problems. These problems are yours as well as ours. We are all in the same boat. The more suggestions and co-operation we get from you the better we like it."

It was also agreed at the meeting that a supplemental contract between the municipalities and the commission will be necessary inasmuch as it was conceded that the contract price of $20,350,000 will be exceeded.

Regional Plan of New York to Be Published in 1928

A comprehensive regional plan of the metropolitan area of New York is to be published in the spring of 1928, according to an announcement by Frederic A. Delano, chairman, Regional Plan of New York and Its Environs, at a meeting of the Regional Council held in New York City, June 6. The purpose of the meeting was to discuss those features of the regional plan which the plan commission feels should receive immediate attention and also to take action looking toward the formation of local committees or commissions in the various communities within the region, so that each community will be in a position to develop the details of its local plan to fit in with the general details of the complete plan.

The plan commission is of the opinion that the thing that the region needs most at the present time is better facilities for circular traffic to supplement the present radial lines. For this purpose it recommends the removal of the west side tracks from grade on Manhattan Island and the opening of the Marginal Way on the present level, provision for increased traffic from the Holland tunnel to Manhattan bridge, construction of a widened highway between downtown Brooklyn and Astoria, construction of the Tri-Borough bridge with improved communication across Manhattan Island to the Hudson River bridge, construction of proper approaches to the Hudson River bridge on the New Jersey side, and construction of an East River vehicular tunnel and its ultimate extension across Manhattan Island and under the river to New Jersey. For the southern part of the area, the plan commission recommends a widened highway from Long Island City through central Brooklyn to the Narrows, with improved ferry service across the Narrows until such time as a tunnel will be necessary, improved routes across Staten Island to the Elizabeth and Perth Amboy bridges, and an improved route from the Elizabeth bridge around Elizabeth and Newark to the Hudson River bridge at 178th St. The plan commission recommends that wherever possible the major traffic routes be developed as parkways along the same lines as the present Bronx Parkway, in order to build up residential sections and so increase the land values.

Los Angeles Aqueduct Dynamited Three Times in Two Weeks

On June 5 the Los Angeles aqueduct was damaged by dynamite for the third time in two weeks. This latest blast was discharged under the open canal section in Owens Valley, a few miles south of Lone Pine and near the Cottonwood power plant. Damage was slight and officials expected to complete repairs June 6.

The aqueduct was dynamited in two places on May 27 and 28, presumably as another gesture in the warfare between residents of Owens Valley and the city. On June 2 it was estimated by engineers of the Los Angeles Bureau of Water Works and Supply that the repairs would be completed by June 8. Large storage reservoirs at the Los Angeles end of the aqueduct prevent danger of any interruption in the city's water supply from a short shutdown of this sort. The latest of several previous dynamitings was reported in *Engineering News-Record*, May 20, 1926, p. 827.

Of the two blasts the greater damage was done by the one 170 miles north of Los Angeles in No-Name Canyon siphon, below Haiwee reservoir which is at the south end of Owens Valley. The charge was exploded under the low point of the siphon adjacent to the angle point, where the plate thickness is $\frac{9}{16}$ in. The diameter of the pipe at this point is 9 ft. 3 in. The damage was considerably increased by the fact that at the time of the blast there was a flow of about 380 sec.-ft. in the aqueduct. The length of pipe destroyed by this blast, collapsed by vacuum or washed out by the escaping water, totaled 476 ft. This included 108 ft. of $\frac{9}{16}$-in. plate, 94 ft. of $\frac{1}{2}$-in., 85 ft. of $\frac{7}{16}$-in., 85 ft. of $\frac{3}{8}$-in., 72 ft. of $\frac{5}{16}$-in., and 32 ft. of $\frac{1}{4}$-in. The pipe is of lap-joint construction, triple riveted on the longitudinal seam.

Three Los Angeles pipe manufacturers were employed to fabricate the new pipe sections needed, all of which were made in single ring sections 8 ft. in width. The first shipment of new sections left Los Angeles by motor truck on the night of May 28. Riveting in the field started May 31.

The second blast, fired shortly after midnight on May 28, tore away two 30-ft. sections of flanged welded steel in the penstock supplying the Big Pine power house which is in Owens Valley about 16 miles south of Bishop. The sections destroyed were replaced with riveted steel flanged pipe 24 in. in diameter and $\frac{1}{4}$ in. thick. The plant was again in operation at 6 a.m. on June 2.

VIEW OF DYNAMITED SIPHON AT NO-NAME CANYON
Note man in the lower left-hand corner

New York May Not Claim Loss of Power by Chicago Diversion

The Supreme Court has ruled that the claim of New York State that it has suffered a loss of power at Niagara Falls and on the St. Lawrence River through the diversion of water from Lake Michigan at Chicago, should be stricken from the proceedings now before the Court to determine whether the Chicago diversion has a deterimental effect upon the other states adjoining the Great Lakes. The court ruled that this point would not be considered on the grounds that New York is not now being deprived of water for power development by the diversion. All the water that may be diverted from the Niagara River for power purposes is now being diverted and little is being developed on the St. Lawrence.

The court indicated that ruling out this feature did not affect the other claims to the effect that the diversion caused a lowering of the lake levels and consequently was a detriment to navigation.

H. A. Van Norman Injured on Los Angeles Aqueduct Repair Job

H. A. Van Norman, assistant chief engineer, Los Angeles Bureau of Water Works and Supply, who had been continuously in the field since the dynamiting of the Los Angeles aqueduct, personally directing the repair, was injured on May 31 in an automobile accident on the Mint Canyon Road just north of Saugus. Three others in the car with Mr. Van Norman were also injured, one sustaining a broken back. Mr. Van Norman's injuries consist of a broken jaw and a broken bone in the left arm just below the shoulder. He is expected to be out again in about three weeks.

Full Report on Mississippi Asked by Jadwin

While the act providing for the special spillway study on the lower Mississippi calls for reports on sites below Old River, Major-General Edgar Jadwin, the Chief of Engineers, has asked the board to study as well the proposal to develop 250,000 sec.-ft. from the Mississippi at Cypress Creek above Arkansas City.

Because of this year's floods the number of advocates of the so-called Cypress Creek spillway has increased greatly. In order that all facts may be available General Jadwin has ordered a comprehensive engineering report on the project.

As it is apparent that Congress will give consideration to reservoirs as a supplemental means of flood control on the Mississippi, General Jadwin also feels that a carefully prepared engineering report should be available for use in that connection. With that in view he has appointed a reservoir board consisting of officers whose experience qualifies them particularly for study of this sort. The personnel of the board is: Major Thomas M. Robins, head of the civil section of the office of the Chief of Engineers; Major Daniel I. Sultan, resident member of the Board of Engineers for Rivers and Harbors; Major Richard T. Coiner, district engineer at Portland, Ore.; Major Milo T. Fox, in charge of river and harbor desk, office of Chief of Engineers; and Major James W. Bagley, of the faculty of the engineer school, Washington, D. C.

Welded Factory Building Under Construction at Derry

An arc-welded kiln tunnel building is being constructed by the Jones & Laughlin Steel Corporation for the Westinghouse High Voltage Insulator Co., at Derry, Pa. This building is L shaped, 460x303 ft., covers 2 acres and varies in height between 15 and 25 ft. The weight of structural steel is 336 tons, of which 204 tons were shipped as plain material without passing through a fabricating shop.

In laying out the job for welded construction, advantage was taken of the experience gained in previous operations to reduce costs. Continuity of connection for purlins permitted the use of 7-in. I-beams on 20-ft. spans. The rafters, mainly 18-in. I-beams 30 ft. long, could not be made continuous because the roof bays were alternately high and low. The design for an equivalent riveted structure, which was prepared for competitive bidding, called for approximately 365 tons, or 8½ per cent more than the design for the welded structure. The weight saving in the welded design would have been 7 tons greater had not I-beams been substituted for some light trusses shown on the riveted design.

Erection bolts are being used for all members except the purlins, which are lowered into short pieces of 5-in. channel welded to the rafters with flanges turned up. Rafters, which connect with the column flanges, have been prepared for erection by welding connection angles to the webs of the rafters, the outstanding legs on these angles having been punched to match holes in the columns. One such angle occurs at each end of each rafter, and each angle has two holes. Wooden templets were used to locate the angles on the rafters, and the angles were secured by clamps until welded. This welding was done on the ground, but might as well have been done in a shop if circumstances had made it economical to send the rafters to a shop instead of shipping them directly from mill to job.

This building requires about 1880 lin.ft. of fillet welding and 320 cu.in. of butt welding; 800 ft. of the fillet welding was done on the ground before erection. Two sizes of fillets are used, ¼-in. and ⅜-in. The Jones & Laughlin Steel Corp. is under contract with the owners for the steel construction complete including welding, the contract price being slightly lower than the lowest bid obtained for a riveted structure. Data on actual cost will be published after completion of the work.

The architect for the building is B. H. Prack of Pittsburgh. Welding details were prepared by Gilbert D. Fish, consulting engineer of New York, who is directing the welding operations. A. M. Candy, welding engineer of the Westinghouse Electric & Manufacturing Co., is making periodic inspections of the welding. All welding of buildings for Westinghouse companies is under the general direction of W. S. Rugg, vice-president in charge of engineering.

Engineering Fifty Years Ago

From *Engineering News*, June 9, 1877

IT IS proposed to build a railroad from San Antonio, Texas, to the Rio Grande at the most convenient point, for the purpose of opening up the country west of San Antonio. In view of the importance of such a line from a military point of view, especially in the present disturbed state of the Mexican border, an effort is to be made to secure aid from the federal government.

Suspension Design Adopted in Place of Arch

After the decision of the city of Cologne, Germany, to adopt an 1,100-ft. arch design for a new bridge across the Rhine (*Engineering News-Record*, Feb. 17, p. 275), the decision was reconsidered and on May 19 the authorities adopted a suspension design in place of the arch design. The main span of the suspension bridge will be about 1,033 ft. long. The cables are to be assembled of locked-coil rope as made by Felten & Guilleaume, of Cologne. The general contractor is the Harkort Co. of Duisburg and the contract price is approximately 12,000,000 marks.

State Sanitary Engineers Adopt Three Final Reports

Three final reports were adopted and ten progress reports were presented at the eighth Annual Conference of State Sanitary Engineers, held in Chicago June 4-6. In addition there were papers and discussions on several topics. On Sunday, June 5, there was an all-day bus trip with "field inspections" of (1) the water filtration experimental plan of the city of Chicago, where laboratory studies are being made and a working-scale testing station is being built; (2) the North Side sewage-works of the Chicago Sanitary District, now under construction and including pre-sedimentation and the activated-sludge process; and (3) and (4) milk pasteurization and bottling plants with respective daily capacities of 150,000 and 200,000 qt.

Officers for the ensuing year are: Chairman, H. E. Miller, Raleigh, N. C., and vice-chairman, E. S. Tisdale, Charleston, W. Va. A. P. Miller, sanitary engineer, U. S. Public Health Service, is secretary of the conference.

Conference Membership

The conference now has 46 full and 83 associate members, the former being chief engineers of state health or similar departments, and two engineers of the U. S. Public Health Service. The associate members are assistant state health engineers. Provision was made for affiliate members—from health departments of foreign countries. Hereafter, the conference will meet with the American Public Health Association instead of the American Water Works Association.

The final reports sent to letter ballot were those of the committees on Sanitary Conservation of Streams, on Swimming Pools and Public Bathing Places and on Ground Water Supplies. Other committee reports on the program were those of the committees on Water Purification and Treatment, Milk Sanitation, Hand Pumps (for rural water supplies) Sewage Treatment, Camp and Outdoor Sanitation, Ventilation, Sanitation of Real Estate Developments and Shellfish. Among the subjects for round table discussion were sodium aluminate as supplementary to alum for coagulation; standardization of chlorine tank valve connections; and chlorination of well water.

New Committees

New committees were created on Catastrophes and Disasters, with J. H. O'Neill, New Orleans, as chairman; on Rural Plumbing Codes and Septic Tank Standardization, and on Recreational Uses of Water Supply Reservoirs, chairman to be announced later. A proposal for a small committee to review and correlate reports while on the table and to suggest new studies was referred to F. H. Waring, Columbus, Ohio, and Abel Wolman, Baltimore, Md., for report to the executive committee. The Conference voted to recommend for consideration by the Surgeon-General, U. S. Public Health Service, the creation of an Advisory Committee on Standards of Milk for use on interstate carriers.

Flood-Control Mass Meeting Held at Chicago

That the definite planning of methods of control of the Mississippi River is work for the engineer was admitted by Senator Harrison, of Mississippi, in his address opening the flood control mass meeting held at Chicago on June 2 to 4. However, the meeting had little to do with engineering, being held on the joint call of the mayors of New Orleans, St. Louis and Chicago for the purpose of urging Congress to "do something." This urge consisted in the adoption of a set of resolutions. A series of speeches more or less general in character composed the main part of the proceedings, in which the engineer had little part. Speakers in official position included D. F. Davis, secretary of war; Major-General Edgar Jadwin, chief of engineers, U. S. Army, and W. B. Greeley, chief of the U. S. Forestry Service. Colonel Greeley explained that reforestation is but a small factor in flood prevention. General Jadwin's address was a compact and concise presentation of the Mississippi problem and its conditions, the means already undertaken to handle it, the numerous ideas proposed for its solution, and the steps already commenced with an appropriation by Congress to study it anew in the light of the recent flood. He contended that a system of levees, with some supplementary works, is amply able to control the floods and at reasonable cost, but their construction and maintenance must be in the hands of the government, in order to insure uniformity of control. He showed the impracticability of reservoirs and the further impracticability of using flood-control reservoirs for development of power.

The principal resolution adopted at the meeting recommended that the federal government should assume entire responsibility for control of Mississippi River floods and that Congress should provide for the prompt carrying out of such effective means of control as may be adopted. It was suggested also that the president should call a conference of engineers and others to consider comprehensive plans for flood control and also for inland navigation.

Additional Tunnel Under Hudson Favored in New Jersey

A report favoring the extension of the present Queens Borough tunnel from its terminus at 41st St. and 8th Ave. in New York, westward under the Hudson River to New Durham, N. J., has been published by the North Jersey Transit Commission. The commission estimates that the cost of the extension would be about $33,000,000.

The commission estimates that the tunnel should carry about 103,000 people when opened and that this number should increase by 50 per cent in 1945. This estimate is based upon the assumption that the commission's proposal to build a terminal at New Durham, at which the passengers from the major steam railroad lines passing that point could reach the tunnel, will be put into effect.

Brief News

Construction of a 15-Mile Extension of the California, Arizona & Santa Fe Ry., a subsidiary of the Santa Fe, from a point on its present line near Beardsley, Ariz., has been authorized by the Interstate Commerce Commission. The estimated cost of the work is placed at $336,787.

The Oregon Trunk Ry. Has Accepted the terms laid down by the Interstate Commerce Commission in its order, authorizing the railway to build from Bend to Klamath Falls, Ore., reported in these pages May 26, p. 879.

Two Automobiles Which Collided on an old iron truss highway bridge of about 105-ft. span, north of Richfield Center, Mich., on May 31, caused the destruction of the bridge. One of the cars was deflected against the truss at one side of the roadway and knocked it off its support. The bridge twisted around, the wrecked girder falling to the bottom. It is said that the bridge was built more than 30 years ago.

The Freeman Fund Committee of the Boston Society of Civil Engineers will receive applications for the award of one or more traveling scholarships covering one year's study in the hydraulic laboratories in Germany up to June 20, 1927. One scholarship of $1,800, or perhaps two of $1,200 each, will be available for tuition, traveling and living expenses. The scholarships are available through the gift of John R. Freeman.

To be eligible for this scholarship, a candidate shall be an American citizen, not less than 24 years of age, who is a graduate of a technical school of recognized standing and is now engaged in the teaching of or in the active practice of hydraulic engineering. Applications can be addressed to the Freeman Fund Committee, c/o secretary, Boston Society of Civil Engineers, 715 Tremont Temple, Boston, Mass.

The American Association of Engineers meeting in annual convention this week, adopted June 5, a resolution commending Capt. Charles A. Lindbergh, for his "matchless courage and superb confidence" in making the transatlantic airplane flight. The association conferred honorary membership on the young flier, he being the second to be thus honored. The first honorary membership was conferred on M. E. McIver, acting secretary of the association.

Governor Smith of New York has appointed a commission to make a study of the port of Buffalo and the Niagara frontier to determine whether a port authority to be known as the Buffalo and Niagara Frontier Port Authority should be appointed. The commission is to report to the state legislature in January, 1928.

For a Study of Sewage Disposal at Troy, N. Y., the study to be made by the City Planning Commission, the sum of $3,000 has been provided. On receiving information to this effect from Harry E. Clinton, mayor of Troy, Dr. Mathias Nicoll, State Commissioner of Health, Albany, wrote to the mayor expressing "the hope that there may be no unnecessary delay in obtaining the services of a competent engineer to undertake this work."

Detroit to Vote June 28 on International Bridge

The ordinance permitting the American Transit Co. to cross certain west side streets in Detroit with the approach of the proposed $21,000,000 bridge connecting Detroit and Windsor, Ont., was passed unanimously by the Detroit City Council May 24, and at the same meeting, June 28 was set as the date for a special referendum election on the ordinance. The cost of the special election, estimated at about $45,000, will be borne by the bridge company.

The ordinance as passed by the council carries substantially the same provisions as were contained in the permit resolution passed several weeks ago and vetoed by Mayor Smith. The mayor has signed the recent resolution calling for the special election and has withdrawn his petition for an injunction restraining the bridge company from proceeding with its plans for crossing Detroit streets.

At the request of the City Plan Commission, a clause was inserted in the ordinance which provides that the bridge must be constructed and maintained so as not to interfere with the master plan for Detroit which designates proposed superhighways.

Preliminary construction work is going on on private property near Fort St. and Twenty-first St. In order to retain the government permit, it was necessary for the bridge company to begin operations before May 13, of this year, construction must be continued at a speed satisfactory to the War Department, and the bridge must be completed within five years from the date of beginning of construction work.

More Railway Construction in Rio Grande Valley Authorized

The Interstate Commerce Commission has authorized the construction of about 50 miles of railroad in the irrigated section of the Rio Grande valley near Brownsville, Tex., in addition to that already under construction. It has authorized the San Benito & Rio Grande Valley Railway Co., a subsidiary of the Missouri Pacific, to construct a 6-mile branch line in a northerly direction and a 16-mile southerly branch toward Point Isabel. The Missouri Pacific proposed to run this line to a connection with the Rio Grande Railway Co., 5 miles from Point Isabel, but this was denied and decision as to the advisability of such a connection postponed for future consideration. The San Antonio & Aransas Pass Ry., a subsidiary of the Southern Pacific, has been authorized to extend its line from Falfurrias to Harlingen, now under construction, to Brownsville, a distance of about 30 miles.

Personal Notes

LOTHER W. SCHURGAST has moved from St. Petersburg, Fla., to Cincinnati, Ohio, to become associated with the Fisher DeVore Construction Co., as estimator and construction engineer. Mr. Schurgast is a graduate of the University of Karlsruhe, Germany, and was one of the first to graduate in a newly established department as reinforced-concrete engineer. He was active in his special line of reinforced-concrete industrial buildings for several years in Germany before coming to the United States.

MARSHALL G. FINDLEY has been appointed structural engineer for the Milwaukee Harbor Commission, Milwaukee, Wis., and has resigned his position with the Illinois Steel Warehouse Co., of Chicago. Mr. Findley was lately with Toltz, King & Day, Inc., of St. Paul, Minn., and formerly with the Board of Commissioners of the Port of New Orleans, La.

JOHN LYLE HARRINGTON, Kansas City, Mo., senior member of the firm Harrington, Howard and Ash, has been elected by the Board of Trustees of Robert College, Constantinople, to serve as a member of that board. Mr. Harrington is particularly interested in the engineering school of Robert College, in which twenty-five students are being trained at government expense and later will set about installing sewage systems, water and electric light systems in the interior of Turkey.

PERRY MCKEE TEEPLE, for nine years on the staff of the University of South Carolina, has resigned his post of associate professor of engineering to devote time to private practice, particularly hydraulic investigations on the Saluda River hydro-electric development near Columbia, S. C., for the Lexington Water Power Co. Mr. Teeple was in government engineering service on the Ohio River before going to South Carolina in 1920. He is a graduate of Lehigh University.

ERIC GUSTAF ERICSON, assistant to the chief engineer, Pennsylvania Railroad System, retired from active service May 31, after nearly 44 years of work with the Pennsylvania R. R. Mr. Ericson is a native of Ramdala, Sweden, and a graduate civil engineer from the Royal Polytechnic Institute of Stockholm, class of 1880. He came to this country in 1883 and entered the service of the Pennsylvania Company at Pittsburgh the same year. In 1886 he was promoted to be supervisor of the Eastern Division, P. F. W. & C. Ry., with headquarters at Worcester and Mansfield, Ohio. This position he held until in 1890 he was promoted to be engineer of maintenance-of-way of the C. & M. V. Ry. at Zanesville, Ohio. In 1893 he went to the Western Division of the P. F. W. & C. Ry. at Fort Wayne, Ind. In 1901 he was promoted to be assistant engineer in charge of construction and maintenance in the office of the chief engineer of Pennsylvania lines west of Pittsburgh, becoming principal assistant engineer of the Northwestern system in 1903. During the period of government control Mr. Ericson was principal assistant engineer of construction on the entire system west of Pittsburgh, and in 1920 with the consolidation of lines west of Pittsburgh, and lines east, Mr. Ericson was appointed to the position which he held until his retirement.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, French Lick, Ind., June 20-24, 1927.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, New York City; Annual Meeting, Orono, Maine, June 27-30, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Summer Meeting, Denver, Colo., July 13-16, 1927.

The Essex County Chapter, New Jersey Society of Professional Engineers and Land Surveyors, will have its next meeting June 15, with a dinner, at the Y.M.C.A., Newark, N. J. Maylon Parsons, principal engineer in charge of the Bureau of Docks, Newark, will give an illustrated talk on "Port Newark Terminal Development Project."

The Engineers Club of St. Louis, Mo., elected on May 25 as officers for the coming year: President, W. W. Horner, engineer in charge of streets and sewers, St. Louis Board of Public Works; vice-presidents, A. S. Hawks, F. C. Woermann, of Woermann Construction Co., and W. E. McCourt, dean of the school of engineering and architecture, Washington University; secretary, C. W. S. Sammelman; and treasurer, W. O. Pannell.

The Baltimore Section, American Society of Civil Engineers at its annual meeting May 24 elected the following officers: President, Steuart Purcell; vice-president, C. E. Keefer; and secretary-treasurer, W. R. Edwards.

The Institution of Civil Engineers (British Empire) held its annual general meeting May 10 in London and elected as officers, to take effect in November, 1927, the following: President, Ernest F. Crosbie Trench, London; vice-presidents, Sir Archibald Denny, London, Sir John Francis Cleverton Snell, London, and George W. Humphreys, London; and members of Council from England, India, Australia, South Africa, New Zealand, and Scotland.

The Columbus, Ohio, Engineers' Club at a dinner May 20 installed its new officers: President, R. W. Waid, of the state auditor's office; vice-presidents, R. H. Simpson and Gen. H. M. Bush; and secretary-treasurer, C. D. McGuire.

The American Society of Agricultural Engineers at its recent annual election by letter ballot selected the following officers: President, Col. O. B. Zimmerman, experimental engineer, International Harvester Co.; vice-presidents, Arthur Huntington, public relations department Iowa Railway and Light Corporation, and Deane G. Carter, professor of agricultural engineering, University of Arkansas; treasurer, Raymond Olney, St. Joseph, Mich.; and member of the council, A. H. Hoffman, research specialist in agricultural engineering, University of California.

The Trenton, N. J., Engineers Club has elected as officers for the coming year: President, Japhet B. Woolston, assistant engineer of New Jersey state board of taxes and assessments; vice-presidents, Charles P. Wilbur, New Jersey state forester, and William C. Kuhn, sales engineer, American Steel & Iron Co.; and secretary, H. G. Acock, consulting engineer.

The Society of Engineers of Eastern New York was a guest on May 26 of the Mohawk Carpet Mills, Inc., Amsterdam, N. Y. Guides conducted the members of the society through two divisions of the plant and explained equipment and processes.

Obituary

LORD COWDRAY (Sir Weetman D. Pearson), a noted English contractor, head of S. Pearson, Ltd., and subsidiary companies, died suddenly May 1, at his residence in Aberdeenshire, England, aged 70 years. The baronetcy was conferred in 1894 for the opening of the Blackwall tunnel under the Thames. Lord Cowdray was born in Yorkshire, was educated privately, and, after a short apprenticeship, was in 1875, made a partner of the firm founded by his grandfather, S. Pearson. Noted construction work carried out by the firm includes the extension of Dover harbor, docks in London, Southampton and Hull and at Malta, a dam over the Blue Nile above Khartoum, and in the United States the construction of four tunnels under the East River at New York for the Pennsylvania R. R.

CHARLES G. DARRACH, civil engineer, Philadelphia, Pa., died June 1, at his home, after several months' illness, at the age of 80 years. Mr. Darrach was formerly assistant chief engineer of the Water Bureau of Philadelphia, and afterwards became a member of the firm of Wilson Brothers, architects and engineers of Philadelphia, engaged on the design and construction of office buildings and institutions in the city and of certain neighboring water-works systems.

ROBERT CRAIG, assistant civil engineer for the Missouri Pacific R. R., died, June 2, in a hospital in St. Louis, after several months' illness, aged 63 years. Mr. Craig had been with the Missouri Pacific for fifteen years and prior to that was a civil and mining engineer in Colorado and other western states.

C. F. W. BRAEGER, chief structural engineer of Graham, Anderson, Probst & White, Chicago, Ill., died May 16, in Chicago, aged 64 years. Mr. Braeger was chief engineer on the Chicago union station, the union station in Washington, D. C., and the Equitable Building in New York.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

Concrete Road Yardage

For May the square yardage included in concrete pavement contract awards according to the Portland Cement Association was: 8,234,755 for roads; 5,601,627 for streets; and 397,220 for alleys; or a total for the month of 14,233,602 sq.yd.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1927

Month	Roads	Streets	Alleys	Total All Classes
Jan.....	2,656,118	1,504,059	75,352	4,235,529
Feb.....	2,336,031	1,935,262	119,382	4,390,675
March	5,134,974	3,866,102	298,667	9,299,743
April	10,264,336	4,931,954	285,924	15,482,214
May	8,234,755	5,601,627	397,220	14,233,602
Totals	28,626,214	17,839,004	1,176,545	47,641,763

One Hundredth Anniversary For Graphite Company

Joseph Dixon Crucible Co., Jersey City, N. J., is this year celebrating its 100th Anniversary dating from the founding of the business in Salem, Mass. in 1827 to manufacture articles from graphite. The company's growth and development during the past hundred years has centered around this same raw material. Besides the manufacture of graphite crucibles the company is now one of the largest manufacturers of pencils, graphite lubricants and protective paints. In commemoration of the anniversary the company has issued a 32-page booklet entitled "A Tale of Yesterday, Today, and Tomorrow," by Floyd W. Parsons, the same being a recital of the business philosophy, history and tribulations of the company during the past 100 years.

Business Notes

VERGAN-SCHMIDT CO., Champaign, Ill., recently completed a new modern plant for the manufacture of its Tractocrane unit built around a Fordson or McCormick-Deering tractor.

FRANK T. CRAVEN is now associated with Fox Bros. & Company, Inc., 126 Lafayette St., New York City, in charge of the contractors' equipment and supply department.

LINCOLN ELECTRIC CO., Cleveland, announces the appointment of the Wade Engineering Co., Los Angeles, Calif., as distributor of its products in that state.

STEVENS-ADAMSON MFG. CO., Aurora, Ill., has recently opened a complete manufacturing plant at Belleville, Ontario, from which will be supplied its complete line of conveying machinery for the Canadian trade in addition to a general export business to foreign markets. G. A. Freeman, for 15 years associated with the main organization in an executive capacity, will be in charge of the new plant.

AMERICAN PAULIN SYSTEM, INC., San Francisco, announces that Harry Lindblom, formerly of Stockholm, Sweden, has become its chief engineer and is located in San Francisco. Mr. Lindblom was assistant chief engineer of the factory manufacturing Paulin instruments in Sweden.

G. A. MECKEL, superintendent, William B. Scaife & Sons Company, Oakmont, Pa., died suddenly May 16. On May 28 Mr. Meckel would have completed 64 years of continuous service with the company, 51 of which he served as general superintendent of the mill. During his association with the company he developed and perfected many improved methods of tank construction.

New Developments

Six-Ft. Rigid Rule May Be Coiled to Pocket Size

A novel rule composed of one continuous metal strip which according to need can be converted from a straight, stiff rod to a convenient coil, is being manufactured by Hiram A. Farrand, Berlin, N. H. The rule exhibits two seemingly opposed characteristics—rigidity and flexibility. The structure of the rule strip is so devised as to offer resistance to bending up to a certain amount of stress, after which it yields readily. This alteration from a relatively rigid state to that of an elastic one takes place all at once, following which the rule is easily run into a coil. As a measure of stiffness the rule will support itself as a cantilever for a distance of approximately 5 ft. from the point of support to its free end.

The rule is claimed to be practically unbreakable and automatically works out of kinks and tangles. The further outstanding feature of the rule is speed. On the pressure of a finger the rule darts straight out ready for use. In fact, it works so swiftly that a brake is necessary to stop it. Pushing in on the rule endwise carries it back into the holder in coiled form. In use the rule may be let out to any desired length and held ready for use. Any unreleased portion remains coiled within the cup and no further extension can take place so long as the brake remains clamped upon the rule strip.

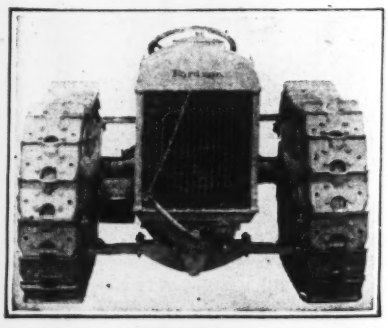
New Trench Hoe Equipped with Goose-Neck Boom

A trench hoe equipped with a goose-neck boom has been designed by the Harnischfeger Sales Corp., Milwaukee, Wis., as one of the eight attachments which can be used on its excavating machines. This goose-neck boom permits digging to a greater depth than is possible with the old straight type of boom. It digs to a depth of 24 ft. and has a working reach of 36½ ft. The trench hoe is available on the company's 1 yd. and 1¼ yd. machines. The 1 yd. machine, model 600, cuts a trench from 38 to 42 in. in width, while the 1¼ yd. model 700, cuts a trench from 46 to 52 in. in width. The dipper can be dumped from the front or bottom and the dipper door is provided with a special patented locking device.

Wide Gage Crawler, a New Fordson Attachment

A wide gage or standard gage, as it is called to distinguish it from the narrow gage crawlers manufactured by the Belle City Mfg. Co., Racine, Wis., has been developed having the same measurement between treads as between regular Fordson drive wheels. It will thus accommodate any industrial equipment used on the wheel equipped tractor and that without any special attachments. The machine is clutch controlled, has full Timken roller bearing equipment, Alemite-Zerk oiling system, drop forged treads and saw steel clutch disks running in oil.

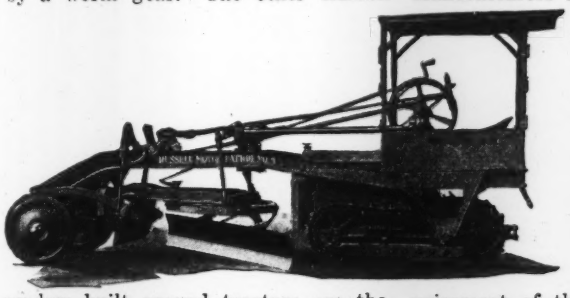
The additional width of the model is obtained, first, by substituting for the regular Fordson axle housings, internally ribbed steel housings of the same contour and with grooves used for attaching the equipment exactly the same distance apart as in the regular hous-



ings; and second, by providing a heavy cast steel saddle on the front end which on either side is bolted to heavy leaf springs. The springs may be replaced by a heavy steel member when it is necessary to attach heavy equipment to the front end of the tractor. Especially important is the accessibility of all working parts and the simplicity of the design.

New Motor Patrol Grader

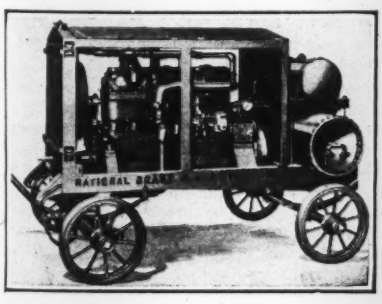
Continuing the policy of adapting its blade and scarifier mechanism to several of the well-known and proven makes of tractors, the Russell Grader Mfg. Co., Minneapolis, Minn., has most recently developed the Russell motor patrol No. 5, built around the "Cletrac" K-20 tractor. The standard length of blade is 10 ft., although other lengths are furnished. The blade circle is 52 in. in diameter, and a clamping device on the circle locks it and eliminates play. A cut worm-gear raising and lowering mechanism is used equipped with bronze bushings and collars throughout. The center shift allows shifting the blade to either side of the machine on a rack and pinion operated by a worm gear. The other Russell



graders built around tractors are the No. 2 using the Fordson tractor, the No. 3 with a McCormick-Deering tractor, and the No. 4 with the caterpillar tractor.

A New Portable Unit-Built Air Compressor

A new air compressor recently developed by the National Brake & Electric Co., Division of the Westinghouse Air Brake Co., at Milwaukee, Wis., claims as its principal feature a total absence of gears, belts, chains or clutches between the power unit and the compressing unit. The engine and compressor are integral and operated from a single crankshaft. The unit as a whole is the mechanical equivalent of a six-cylinder engine with the exception that four cylinders operate as a gas engine and two cylinders operate as an air compressor. The compressor pistons are driven by connecting rods from the same crankshaft and in the same manner as the engine pistons.



The machine is entirely automatic in control. When the air tank has been charged to its maximum pressure the valves of the compressor cylinders are automatically unseated, permitting the compressor to "idle"; at the same time the engine is throttled down to idling speed until the tank pressure falls to the cutting-in point.

The compressor is supplied mounted either on skids or wheels and in sizes of 110 and 160 cu.ft. displacements.

A New Rapid Hardening Portland Cement

Ferrocrete is the name given to a rapid hardening portland cement developing high early strength which has recently been placed on the market in the United States, but which it is said has been widely used in England and continental Europe for the past three years. It is manufactured in the mills of the Associated Portland Cement Manufacturers in England.

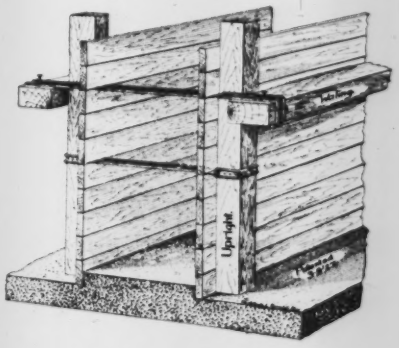
Its high early strength is claimed to be due in large measure to extremely fine grinding. An average of tests in ten different laboratories in the eastern part of the United States is said to have shown it to possess tensile strength in 24 hours equivalent to the twenty-eight day requirement of the A.S.T.M. Not only does its fine grinding provide high early strength, but it also accounts for its rapid hardening and waterproofing characteristics. Although it is rapid hardening, its setting time is normal. Being a true portland cement Ferrocrete requires no different treatment than other portland cements.

The product is especially useful in the construction of docks, sea walls, footings, concrete piles, and similar work where density and watertightness are of special importance. Its high early strength is also important on structures which must be placed in service with a minimum loss of time. In concrete work where a reduction of weight is desirable, without sacrifice of strength, Ferrocrete also claims an advantage since stresses can safely be raised by at least 20 per cent over those allowed for ordinary cement with a consequent reduction in the dead weight of the structure. Precast piles made with Ferrocrete can be driven within five to eight days.

The manufacturers, who operate twenty-eight mills producing many brands of portland cement, now have two mills equipped for the manufacture of Ferrocrete, and a third mill is at present being constructed. The distributor of Ferrocrete in the United States is the Ferrocrete Import Co., Inc., 250 West 57th St., New York City.

New Steel Form Strips Eliminate Spreaders in Concrete Forms

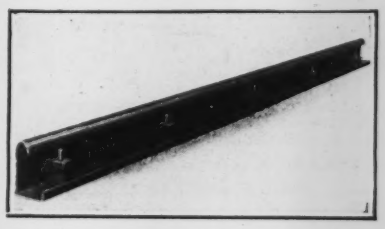
Claiming to cost no more than wire and to eliminate all use of spreaders in concrete forms, the new form strips manufactured by the Hawley Tie Bolt Co., Minneapolis, Minn., are made of 1-in. channel with ¼-in. web and weigh ¼ lb. per ft. Their manner of use is shown in the accompanying illustra-



tion. The strips come in standard lengths of 8 ft. with ⅞-in. holes placed on ¾-in. centers. In using them a length equal to the wall thickness plus enough to wrap around the upright and the waling on two sides is cut off. The strips are flattened with a hammer where they pass through the form boards and are then bent around the upright or waling and nailed securely. One size of strip is adequate for all forms on a job. No damage is done to the forms, the strips being removed by tinner's snips.

Improved Road Forms

The concrete road form known as the Carr road form manufactured by the Lakewood Engineering Co., Cleveland, Ohio, is now provided with four stake

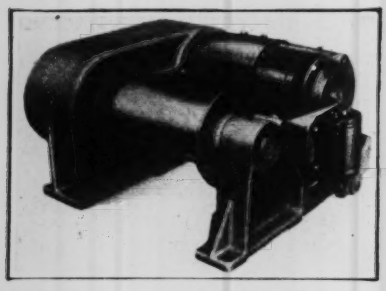


pockets per 12-ft. section. High carbon steel stakes ⅞ in. in diameter are used and the form is locked to the stakes by a simple key wedge.

New Electric Hoist Has Various Applications

A new electric hoist that can be mounted in a fixed position, either overhead or on the ground, or can be placed on skids and used as a portable hoist, is announced by the American Engineering Co., Philadelphia. Uses for the hoist include applications for contractors' work, on derricks, as a car puller, mine hoist, for elevator work in pulling loads up inclines, etc. The standard machine consists of a smooth

drum driven by a motor through a train of spur gears, all mounted on a common bedplate. It is furnished in sizes for handling loads from 500 to 4,500 lb. Motor and gears are completely inclosed, Hyatt roller bearings being used on all gear shafts. The large flanges on the drum prevent the rope jumping the ends and give large stowage capacity. One bearing of the drum shaft



is lubricated by splash from the gears and the other by an Alemite fitting. Either d.c. or a.c. motor can be furnished with a single speed, reversing drum type controller. Various modifications can be made, such as supplying grooved drums, air motors or steam engines, push button or remote control, holding and lowering brakes, etc.

Manufacturers and Trade Associations

Calendar

Annual Meetings

WATERWORKS MANUFACTURERS ASSOCIATION, New York; Annual meeting, Chicago, June 6-10.

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

ASPHALT ASSOCIATION, New York; Annual Convention, Atlanta, Nov. 28-Dec. 2.

New Publications

Elevators and Conveyors—LINK-BELT Co., Chicago, has just issued a 96-p. booklet designated as book No. 575, which covers many types of handling equipment applied to a wide field of industrial conditions. While describing the equipment manufactured by the Link-Belt Co., the illustrations show equipment in a variety of uses, many of which should prove valuable for anyone who has an elevating or conveying problem.

Concrete Pipe Machinery — MCCRACKEN MACHINERY Co., Sioux City, Iowa, has recently published a 23-p. catalog describing its machinery for making concrete pipe with a corrugated surface. The catalog explains the mechanical details of the equipment, describes the pipe and tells something about existing pipe plants both in this and foreign countries. The machines are sold with territorial protection.

Hydraulic Dredges and Pipe Lines—AMERICAN BROWN BOVERI ELECTRIC CORP., 165 Broadway, New York City, has recently published two new bulletins—a bulletin on hydraulic dredges and a bulletin on floating pipe lines for hydraulic dredges, respectively. The first bulletin, No. 900, treats of hydraulic dredge types, their fields of application, hydraulic dredge equipment, factors upon which dredge earning power depend and gives a list of questions for proper ordering of equipment. The second bulletin, No. 901, treats particularly of an improved ball joint for hydraulic dredge pipe lines.

Pump Primers — AUTOMATIC PRIMER Co., Chicago, Ill., has issued a pamphlet describing its automatic primer for use on centrifugal pumps. The principle of operation is explained, drawings and a list of installations given.

Earth Moving Equipment—WESTERN WHEELED SCRAPER Co., Aurora, Ill., has issued a 170-page catalog fittingly commemorating its half century of service to the construction industry. The historical development of the company and its products is presented in text and pictures. All of the company's products are illustrated and described. Dump cars, dump wagons, graders, drags, concrete batch boxes, crushing and screening plants, plows, backfillers, slips, fresnos, wheeled scrapers, ballast spreaders, etc., are included.

Swimming Pools — GRAVER CORP., East Chicago, Ind., has recently issued a 16-p. bulletin entitled "How Los Angeles Protects Her Bathers." It describes the municipal swimming pools, all of which have been equipped with Graver refiltering and circulating systems. The refiltering systems are also described and illustrated in the booklet.

Gratings—ARROWHEAD IRON WORKS, INC., Kansas City, Mo., has issued a 39-p. catalog designed as a handbook of grating and treads for the use of engineers, architects and contractors. The company's various types of grating are described and illustrated. Specifications and drawings are also given to assist in ordering and placing. Such applications as walkways, floors, sidewalks and fire escapes, are considered.

Power Plant Equipment — WORTHINGTON PUMP & MACHINERY CORP., New York City, in a new 32-p. bulletin H. O. 1900, briefly describes its products for use in power plants. The catalog is meant merely to give some knowledge of what Worthington offers, while to special bulletins which are available is left the function of giving in detail the design and capacity range of each type of equipment manufactured. Illustrations and brief text matter are given on steam condensers, centrifugal pumps, steam driven reciprocating pumps, power driven reciprocating pumps, feed water heaters, rotary pumps, deep well pumps, air compressors, Diesel engines, gas engines and water and oil meters.

Pumping Equipment — LUITWIELER PUMPING ENGINE Co., Rochester, N. Y., has made available a catalog describing its equipment as applied to automatic, electric, and hydro-pneumatic pressure water systems. The units of power and pump are mounted upon one base and either electric motor driven, direct connected or geared. A number of illustrations both of design details and of the pumps are given besides descriptions and explanatory drawings of the company's deep well pumping systems.

Arc Welding—LINCOLN ELECTRIC Co., Cleveland, Ohio, has issued a 1927 edition of its Arc-Welding Instruction Manual. Although primarily explaining the installation and maintenance of one company's equipment, nine lessons in arc welding and methods of procedure for standard operations are given which are adaptable generally to arc-welding operations. The cost is $1.

Aluminum Paint — ALUMINUM Co. OF AMERICA, New Kensington, Pa., has issued a new booklet describing its aluminum paint. The booklet combines the material formerly published in the Aluminum Paint Book and the Aluminum Paint Manual of the company.

Flag Poles—JOHN E. LINGO & SONS, 28th and Buren Aves., Camden, N. J., has recently issued a 28-p. catalog describing tubular steel flag poles. The catalog is intended as a guide for architects and engineers. Information is given on erection methods as well as on design and anchoring details. A number of illustrations are given of the flag poles in use.

Lime in Concrete — NATIONAL LIME ASSOCIATION, Washington, D. C., has recently issued a new revision of its Bulletin 301 on watertight concrete. The text and illustrations describe the types of construction upon which lime has been used to make concrete watertight.

Tunnel Mucking — MYERS-WHALEY Co., Knoxville, Tenn., has recently had compiled a booklet describing the use of its shoveling machine in driving the Shandaken, the Hetch-Hetchy and the new Cascade tunnels. Illustrations and drawings are given of the work.

Tractors — CLEVELAND TRACTOR Co., Cleveland, Ohio, has recently published a new booklet on its models "20" and "30" which describes the tractor design, gives specifications and ratings and illustrates both machines together with a number of close-up detail photographs.

Business Side of Construction

Facts and Events That Affect Cost and Volume

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total Contracts
June 9, 1927	$30,198,000	$38,374,000	$68,572,000
June 2, 1927	58,464,000	27,629,000	86,093,000
June 10, 1926	30,536,000	44,577,000	75,113,000
Jan. 1 to date			
1927	522,988,000	794,228,000	1,317,216,000
1926	462,565,000	798,912,000	1,261,477,000

E.N.-R. Index Numbers On June 1, 1927

COST	VOLUME
205.55	299

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	$3.00	$3.00	$3.80
Structural rivets, 100 lb	5.00	3.80	4.75	3.50	3.75	4.65	5.00	5.00	7.00
Reinforcing bars, ¾ in. up, 100 lb	3.24	2.80	2.75	2.30@2.50	2.87½	3.87½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	48%	41%	42@53.8%	48%	37.83
Cast-iron pipe, 6 in. and over, ton	—47.60	42.00	54.00	—44.20	48.50	56.50	—48.00	55.00	62.50
Concreting Material									
Cement without bags, bbl	2.35@2.50	2.35	2.05	2.05	2.22	2.85	2.51	2.65	+1.36
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.70	1.65	1.90	1.80	1.25	1.90
Sand, cu.yd	1.00	1.60	2.00	1.65	1.25	1.00	1.40	1.25	1.35
Crushed stone, ¾ in., cu.yd	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59@61	34.00	56.00	40.50	—39.25	34.25	27.00	23.00	50.00
Lime, finishing, hydrated, ton	18.20	22.00	19.00	20.00	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl	2.10@3.00	1.50	1.82	1.50	1.70	2.70	1.70	2.80	10.00
Common brick, delivered, 1,000	19@20	12.00	14.10	12.00	13.75	9@10	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.076	.072	.085	.....	10	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	076	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal	+.89¼	.93¾	1.10	90	+.99	1.10	+.95	.95	1.05
Common Labor									
Common labor, union, hour	.90⅜	.30	..	.90	.....	.....	60	.62½	.....
Common labor, non-union, hour	.....	.25	30@.50	....	45@.60	.31¼@.50	.50	.62½	.30@.35

PRICES of construction materials, for the nine districts covered by the table, have held firmly during the last two weeks, with the possible exception of cast-iron pipe and fir timbers.

Demand for materials, particularly those used in construction other than buildings, is well abreast of a year ago. Fabricated structural steel requirements are in fairly heavy volume, compared with 1926, as were cast-iron pipe sales up to the recent declines of $1 per ton at New York, $2 in Chicago and $4, f.o.b. San Francisco. Price changes in this table are those compared with May 19, 1927 levels.

Steel quotations display considerable firmness in black and galvanized sheets and reinforcing bars, while those on plates and wire nails are apparently weaker.

Fabricated brass and copper products used in buildings, such as sheets, tubing, etc., together with solder and other non-ferrous metals, are tending downward in the current market.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 2, the next on July 1.

Explanation of prices contained in the table will appear from time to time in this section; last shown in issue of May 19, 1927, p. 837.

PRICE OF STEEL SHAPES PER 100 LB.

City	One Month Ago	One Year Ago
New York	$3.34	$3.34
Atlanta	3.80	3.40
Dallas	4.15	4.15
Chicago	3.10	3.10
Minneapolis	3.35	3.35
Denver	3.87½	3.07½
San Francisco	3.00	3.30
Seattle	3.00	3.35
Montreal	3.80	4.00

Wholesale commodities, not especially related to construction, taken as a group, are reported firmer this week, after a protracted downward price movement which began back in September, 1926, and continued up to the present time.

Steel reinforcing bars, ¾-in. and larger; structural shapes, 3 to 15 in.; and plates, ¼-in. thick and heavier, are $1.90 per 100 lb., f.o.b. Pittsburgh mill. A quotation of $1.80, however, applies on the shapes and plates, where exceptionally heavy tonnages are involved.

Lumber stocks in the Minneapolis and Twin Cities yards are above the seasonal normal, with movement unusually slow owing to backward spring.

Prices of long-leaf yellow pine and Douglas fir timbers, in the other districts mentioned, hold steadily to quotations of May 19, 1927.

Linseed oil rose 1½c. per 7½-lb. gal. at Minneapolis and New York during the week; San Francisco market advanced 6c. per gal.

Special Cost Data Culled From Construction News

IN ADDITION to the unit costs, materials prices and labor rates published weekly and, in greater detail, in the first issue of each month, the Construction News reports offer each week a broad field of special cost data. Following are a few of these data that were contained in construction reports published this year:

Heating and plumbing contract prices compared with total cost of a number of school contracts awarded this year are as follows:

Location	Total	Heating	Plumbing
East Providence, R. I.	$306,380	$29,350	$27,753
Philadelphia, Pa.	1,127,718	86,897	41,868
Philadelphia, Pa.	1,103,913	35,495	41,854
Philadelphia, Pa.	444,773	37,286	27,697
Miami, Fla.	1,094,118	.....	65,995
San Pedro, Calif.	399,974	32,441	25,574
Syracuse, N. Y.	234,000	26,580	.....
Salem, Mass.	423,038	63,243	23,009

$9.70 per sq.ft. of floor space is the cost of a three-story brick and stone addition to the North Side High School at Fort Worth, Tex. There were 26,000 sq.ft. The general contract price was $252,000, exclusive of the plumbing and heating which cost $38,490.

Electric work on a high school addition at Salem, Mass., cost $20,000 or 4.7 per cent of the total contract price.

Subcontract prices on a three-story and basement brick and concrete addition to the West Division High School, of Milwaukee, Wis., contract let in January, were as follows:

	Price	Per Cent Total Cost
(1) Plain foundation, masonry, concrete and excavation	$63,945	48
(2) Carpentry	25,800	19
(3) Structural steel	21,380	16
(4) Plumbing	21,869	17
	$132,994	100

Heating and plumbing prices on a nurses' home in Philadelphia, awarded in April, were $63,333 for the heating and $32,392 for the plumbing. The contract price for the building, exclusive of plumbing and heating, was $348,700. The building is five stories and basement, 124x134 ft., reinforced concrete, brick, terra cotta, limestone and granite, plain foundation.

Road Costs culled from the Construction News Section (May 26 issue) are given in the following comparison of unit prices on various types of paving in different sections of the country, awarded at about the same date:

Type	Place	Per Sq.Yd.
Bitulithic	New Bedford, Mass.	$2.02
Bitulithic, 6-in.	Bridgeport, Conn.	3.16
Vitrified brick; grade and curb	Cleveland, Ohio	6.25
Asphalt block	Toledo, Ohio	6.61
Concrete; grade	Belleville, Ill	2.61
Concrete; curb and grade	New London, Iowa	2.24
Concrete, 6-in.	La Plata, Mo.	2.41
Concrete, 7-in.	Springfield, Mo.	2.05
Concrete, 7-in.	Springfield, Mo.	1.88
Concrete, 7-in.	Trail, B. C., Can.	2.76
Concrete	Baltimore, Md.	2.36
Sheet asphalt	Baltimore, Md.	4.65
Sheet asphalt	Holland, Mich.	2.58
Water bound macadam	Columbus, Ohio	1.53
Traffic bound macadam	Akron, Ohio	1.25

Average hourly wages in cents per hour paid common labor in April on federal-aid roads in various states were as follows: Massachusetts, 50; Vermont, 40; New York, 45@50; Mississippi, 20@22; Kentucky, 30; Iowa, 35; Nebraska, 45.

Reinforcing steel for federal-aid road work awarded in April cost as follows, per pound: 3½ cents in Massachusetts; 4½, 4.9, 5 and 5.5 cents in Nebraska; 5 and 6 cents in Vermont, 4½ and 4⅝ cents in Mississippi; 6½ cents in New York; 8 cents in Washington.

California paving costs per sq.ft. as follows, according to contract prices recently published in Construction News:

City	Paving	Sq.Ft.	Thickness	Sq.Ft.
Los Angeles	Concrete	998,218	8-in.	$0.540
Los Angeles	Asph. conc.	262,234	....	0.179
San Diego	Concrete	1,131,747	....	0.373
Santa Ana	Asph. conc.	370,600	6-in.	0.185

$4.45 per sq.ft. of floor space was bid on a candy factory project in St. Louis. The building is 5 stories and basement, reinforced concrete and brick, and the bid of $1,000,000 includes machinery and refrigeration, etc.

$34,000 for 1.07 mi. is the estimate of the New Hampshire State Highway Department for 3-in., 18-ft. bituminous macadam in Contoocook Valley. This is at the rate of $31,776 per mile.

Reinforcing Steel — The following unit prices (material in place) are included in the low bidders' estimates on various bridge jobs:

Location	Date		Lb.	Price per Lb.
Ballston Spa, N.Y.	Aug.,	1922	65,000	$0.048*
Rochester, N. Y.	Aug.,	1922	10,000	.045*
Clarksville, Tenn.	Sept.,	1922	37,891	.05
Jefferson Co., Wash.	Oct.,	1922	40,000	.045*
Trenton, N. J.	Oct.,	1922	110,000	.06
Montana St. Hy.	Oct.,	1922	10,400	.06
Carrollton-Lexington, Mo.	Dec.,	1922	47,000	.0565
Astoria, Ore.	Apr.,	1923	88,000	.0575
Haverhill, Mass.	June,	1923	1,150,000	.0406*
Charleston, S. C.	Aug.,	1923	1,560,800	.05
San Francisco, Calif.	Oct.,	1923	35,000	.055
Perth Amboy, N.J.	Nov.,	1923	1,322,500	.075
St. Louis, Mo.	Jan.,	1924	398,200	.036*
N. Y. St. Hy.	Feb.,	1924	38,600	.05
Springfield, Mass.	Mar.,	1924	250,000	.07
Klamath River, Calif.	May,	1924	850,000	.059
Idaho St. Hy.	May,	1924	24,500	.06
Ore. St. Hy.	May,	1924	105,000	.06
Delaware River, Phila.-Camden.	Sept.,	1924	300,000	.05
Detroit, Mich.	June,	1925	332,000	.05
Delaware River, Phila.-Camden.	June,	1925	990,000	.06
Broadkill Creek, Del.	Feb.,	1926	10,000	.07
Yonkers, N. Y.	Mar.,	1926	137,000	.07
Chicago, Ill.	May,	1926	720,000	.07
Ottawa, Kans.	June,	1926	114,000	.05
Ariz. St. Hy.	July,	1926	150,440	.05
Tenn. St. Hy.	July,	1926	68,128	.06
Tenn. St. Hy.	July,	1926	253,629	.05
Glenn Ridge, N. J.	July,	1926	250,000	.06
N.Y.-N.J. PT—1A	July,	1926	1,700,000	.05
EH—1A	July,	1926	900,000	.05
McKeesport, Pa.	July,	1926	92,200	.06
Wash. St. Hy.	Aug.,	1926	505,000	.051
Harrisburg, Pa.	Aug.,	1926	800,000	.041*
Fla. St. Rd.	Nov.,	1926	36,492	.05
Wilmington, Del.	Dec.,	1926	74,000	.07
Kans. St. Hy.	Dec.,	1926	51,895	.045*
Va. St. Hy.	Dec.,	1926	41,325	.055
Va. St. Hy.	Dec.,	1926	140,230	.05
Fla. St. Hy.	Jan.,	1927	50,900	.05
Toledo, O.	Jan.,	1927	21,000	.05
Va. St. Hy.	Jan.,	1927	32,660	.055
Fla. St. Rd.	Jan.,	1927	670,000	.06
Kans. St. Hy.	Jan.,	1927	63,716	.04*
Fla. St. Hy.	Jan.	1927	546,500	.06
Va. St. Hy.	Jan.	1927	38,110	.055
Tacoma, Wash.	Feb.	1927	700,000	.041*
Ky. St. Hy.	Feb.	1927	192,800	.06

*Haul, bend and place only.

Structural Steel—The following unit prices (erected and painted) are included in the low bidders' estimates on various projects, 1923 to date:

Location	Date		Lb.	Price per Lb.
Dam, Starved Rock, Ill.	Feb.,	1923	387,000	$0.10
Dam, Merced, Calif.	Nov.,	1923	60,000	.05
Pumping stations, Poughkeepsie, N. Y.	Apr.,	1923	57,000	.085
Coagulation basins, Cleveland, O.	May,	1923	34,000	.10
Waterway, Springfield, Ill.	Sept.,	1923	1,564,000	.10
Conduit, Portland, Ore.	Oct.,	1923	258,000	.0893
Sewage treatment Works, Chicago, Ill.	July,	1923	1,500,000	.085
Powerhouse, Cohoes, N. Y.	Aug.,	1923	560,000	.055
Filtration plant, Albany, N. Y.	Apr.,	1924	26,000	.075
Inspection shed, incl., New York, N. Y.	Apr.,	1925	140,000	.05
Vehicular tunnel, N. Y.-N. J.	Apr.,	1925	1,090,000	.075
Relocation of R.R., Wanaque, N. J.	May,	1925	40,000	.087
Ventilation Bldg., Vehicle Tunnel, N. Y. C.	Oct.,	1925	1,600,000	.046
Viaduct, Jersey City, N. J.	Mar.,	1926	8,940,000	.061
Dam, Pittsburgh, Pa.	June,	1926	2,890	.15
Grade crossing elim., Warren, O.	July,	1926	112,000	.0497
Dam, Golconda, Ill.	Oct.,	1926	817,000	.14
Bridge, P. A.-Tottenville, N. J.-N.Y.	Aug.,	1926	6,000,000	.084
Bridge, Eliz.-Howland Hook, N.J.-N.Y.	Aug.,	1926	3,400,000	.0788
Bridge, Harrisburgh, Pa.	Aug.	1926	400,000	.055
Bridge, Dunellon, Fla.	Nov.,	1926	140,000	.0675
Bridge, Kan. St. Hy.	Dec.,	1926	36,653	.085
Bridge, Toledo, O.	Jan.,	1927	300,000	.072
Bridge, Green Cove Springs, Fla.	Jan.,	1927	165,000	.08
Bridge, Kan. St. Hy.	Jan.,	1927	48,000	.085
Bridge, Fla. St. Hy.	Jan.,	1927	165,000	.08
Road improvement Kans. St. Hy.	Feb.,	1927	28,140	.061
Mo. St. Hy.	Jan.,	1927	189,060	.063
Street improvem't, Chicago, Ill.	Feb.,	1927	140,000	.075

Concrete for Highway Bridges $17.25 and Up Per Cubic Yard

Prices bid for Class A (1:1½:3) concrete on bridge contracts range from $17.25 per cu.yd. to $65, according to the unit-price lists published in *Engineering News-Record* this year. The lowest bid was in connection with a concrete viaduct in Santa Ana County, New Mexico. The higest bid was in Florida, where the average was $39 per cu.yd. compared with $27.60 which is the average of the sixteen jobs.

Cu.Yd	State	Per Cu.Yd Low	Average	High
1,713	Arkansas	$20.00	$27.90	$40.50
430	Florida	24.50	40.30	65.00
1,665	Florida	26.00	32.10	42.50
458	Florida	31.00	44.60	65.00
331	Florida	24.00	25.60	27.80
663	Kansas	20.00	20.80	22.00
376	Kansas	20.00	21.25	23.00
1,653	Kentucky	24.00	26.00	28.00
383	Kentucky	22.00	26.00	29.00
2,100	New Mexico	17.25	21.00	26.20
2,450	New York	20.00	27.20	42.00
188	Virginia	22.00	23.80	25.00
311	Virginia	26.00	28.20	29.60
558	Virginia	26.50	27.80	29.00
152	Virginia	23.00	25.70	30.00
1,000	Washington	20.00	23.20	26.00
Average of sixteen jobs		$23.00	$27.60	$34.40